The University of Utah

Pre-Disaster Mitigation Strategy

September 2009

Developed through funding provided by:

The Federal Emergency Management Agency
Pre-Disaster Mitigation Competitive Grant Program

and

The University of Utah

A. Executive Summary

A.1 Pre-Disaster Mitigation Planning

In 2005, the University of Utah decided to commit resources to the development of a mitigation plan designed to reduce its exposure to loss of life or property in event of certain types of disaster or catastrophic occurrences.

Under the Disaster Mitigation Act of 2000 (42 USC 5165), a mitigation plan is a requirement in order for an agency or institution to potentially qualify for Federal mitigation funds. The University's mitigation plan was structured to meet the prerequisite for obtaining such funds from the Department of Homeland Security's Federal Emergency Management Agency (FEMA), plus inform the University's own decision makers regarding the most effective use of mitigation funds.

No detailed engineering analysis of individual buildings was performed under the scope of this project. The results should not be considered a reliable prediction of casualties in any specific type of incident and are thus best utilized as a means of contrasting the modeled results for all buildings, in order to establish objectively based priorities. It is to be considered as a guide to the likelihood of disastrous consequences in those incidents.

This document presents the planning process resulting in a set of detailed pre-disaster mitigation strategies that will enable the University to achieve the broad objectives identified above.

A.2 Plan Financing

In 2005, the University of Utah was awarded a Disaster Resistant University grant under the Pre-Disaster Mitigation grant program administered by the Federal Emergency Management Agency. The University of Utah provided a 25% match. The allocation of these funds provided the necessary budget for the University to conduct ground motion studies, structural and non-structural evaluations, analyses of risk associated with potential floods and wildfires, as well as other types of events. Also conducted were analyses of population impacts and the collection of economic impact data, for each individuals building on the main campus of the University. The total budget for the project was eventually authorized at $716,000.

This grant also provided support to the field of disaster management software technology through the redeployment of the HAZUS InCast desktop software program as an open-source, web-based, multi-user application.

A.3 Planning Process

§201.6(b)

A.3.1 Plan Developers

§201.6(c)(1)

A.3.1.1 Project Team

The administration at the University immediately determined that the project would benefit from the leadership of a project team with significant in-house expertise. Such a team was ultimately formed by July, 2006. Its members brought to the project invaluable expertise in emergency planning, institutional processes, and information technology. Understanding the de-centralized nature of this institution, the project team had to possess skills and knowledge that could produce a body of work that updated and brought together multiple sources of information from multiple, often disparate campus operations into one reference.

A.3.1.1(a) Management team

- A.3.1.1(a)(i) Marty Shaub – Director, Environmental Health and Safety and Principal Investigator for the Pre-Disaster Mitigation grant
- A.3.1.1(a)(ii) Wayne McCormack – Advisory Committee Chair
- A.3.1.1(a)(iii) Pete van der Have – Project manager
- A.3.1.1(a)(iv) Stuart Moffatt – Technical manager
- A.3.1.1(a)(v) Hilary Sorensen – Project co-ordinator

A.3.1.1(b) Research team

- A.3.1.1(b)(i) Marty Shaub – Principal Investigator
- A.3.1.1(b)(ii) Dr. Lawrence Reaveley – Co-principal investigator (Structural) with research assistant Jesse Malan
- A.3.1.1(b)(iii) Dr. Ryan Smith – Co-principal investigator (Non-structural) with research assistants Cynthia Argyle, Camille Coons, and Monica Fischli
- A.3.1.1(b)(iv) Dr. Steve Bartlett – Co-principal investigator (Geotechnical) with research assistant Dan Gillins

A.3.1.2 Advisory Committee

Shortly after the formation of the project team, the University's administration appointed a Disaster Resistant University (DRU) Advisory Committee, constituted of representatives from key stakeholder groups on campus as well as from local and state agencies that also have an interest in the successful development of a mitigation plan. Advisory Committee members are listed in *B.2.2.1 Acknowledgement of Plan Participants.*

A.3.2 Considerations

It was quickly determined that the University faces a finite number of definable risks, and that it is possible to quantify these risks in terms of likelihood of occurrence. The impact of any of the risks on critical University functions needs to be identified and quantified before an unpreventable catastrophic event occurs. Accordingly, the project team set out to develop a strategic document that would help guide the management of those risks and their impact on any critical University function--consistent with the needs of the organization, while identifying and prioritizing opportunities to limit or control the consequences, extent, or severity of an incident that cannot be reasonably prevented.

Upon its adoption, the final document offers potential pre-disaster mitigation actions to the next generation of decision makers at all levels of the institution.

The project team, with the guidance and leadership of the DRU Advisory Committee, identified several defining features associated with the University of Utah that had to be considered throughout the development of a plan:

A.3.2.1 <u>It is a large research institution with a renowned medical campus and countless research activities, beyond its base mission of providing highly ranked undergraduate and graduate level educational opportunities to 30,000 individuals.</u>

A.3.2.2 <u>Its urban setting provides an environment that invites a large and mobile population to the campus.</u>

A.3.2.3 <u>Its mission and location combine to create an environment that carries with it the potential risk of catastrophic disaster from natural as well as certain human caused, biological and technological events.</u>

A.4 Public Involvement

Recognizing the benefits of public participation, the project team sought out numerous opportunities for such interactions. A wide range of the University's constituents and stakeholders participated in the development of this document.

The entire planning process could not have had the focus it enjoyed without the wisdom articulated by the DRU Advisory Committee through the formulation of the guiding principles discussed in the following sections.

A.4.1 Integration with existing planning processes

§201.6(c)(4)(ii)

Significantly, this grant caused senior administration and the campus community to engage in mitigation discussions, the most notable outcome of which is the dedication of one entire section of the campus Master Plan to pre-disaster mitigation strategies. The Master Plan references this plan and will be an integral step to monitoring and incorporating future mitigation planning activities.

A.4.2 Stakeholder Participation

A comprehensive list of individuals who participated directly via meetings or consultation are acknowledged in Appendix I.1 Participants / Meeting Record.

A.4.2.1 Publication outreach

The project team published relevant articles in various campus publications promoting and reviewing activities related to the plan's evolution, thereby encouraging public input:

- FYI staff newsletter
- The Daily Utah Chronicle, the campus' daily newspaper
- The PULSE (health sciences) newsletter
- The College of Engineering newsletter
- Continuum—the official magazine of the University of Utah for its faculty, staff, alumni, and community, published quarterly with a distribution of approximately 250,000 copies

A.4.2.2 Faculty, Staff and Student Survey

Toward the end of the process, the project team developed an electronic survey vehicle through *Survey Monkey* that was aimed at students, faculty and staff. To stimulate participation, a prize drawing was offered for those who completed the survey and offered quality feedback.

This proved to be a successful strategy that extended the opportunity of providing input to the entire campus population through face-to-face contact and a full-page advertisement in the Daily Utah Chronicle. Over 3500 individuals registered for the survey and many offered detailed feedback on the recommended mitigation actions contained in this plan. Comments were assimilated into the plan where appropriate.

A.5 Vision

The ultimate achievement envisioned as a result of this effort is the control of issues that the University of Utah would otherwise be forced to address after a catastrophic disaster, primarily determined most likely to be a significant seismic event.

A.6 Mission

This Strategy focuses on defining activities that provide “maximum bang for the buck” and insure the greatest benefit to stakeholders of the University of Utah.

A.7 Strategy

We updated our understanding of risks and the degree of threat posed to the University by known hazards. This led to the development of a strategy that marries the institution’s traditional values as a community with its own distinct culture and values with new findings about the University’s actual hazards and vulnerabilities.

The project relied on members of the University’s community to identify, collect and collate relevant data from various sources in order to better recognize and categorize mitigation opportunities.

A.7.1 Defining Criteria

The project team determined a need for a system that could filter functions and the facilities in which they are housed in terms of “mission criticality.”

The National Association for College and Business Officers (NACUBO) defines “mission critical” as follows:

> *Mission-critical programs and services* are those that are essential to the work of the institution, department, or program and to the purposes for which the organization was created. For educational units, the mission-critical programs and services at most institutions are those related directly to teaching/learning, scholarship, and public service/outreach. (Excellence in Higher Education Guide, Brent D. Ruben, Ph.D., NACUBO, 2007; p. 46)

For their purpose, concentrated exclusively on accreditation, this definition is appropriate.

For the goals of pre-disaster mitigation and disaster resistant university planning, however, a slightly different definition is appropriate. The following sections illustrate the use of this alternate perspective, emphasizing the degree to which a function contributes to the institution's success in reacting to, responding to, and recovering from a natural or human caused disaster.

A.7.1.1 Mission Critical: Uninterruptible

- Functions are critical to the mission of the University or the welfare of the state
- Design should minimize risk of interruption
- In case of interruption, functions must be restored or relocated immediately

A.7.1.2 Mission Core: Urgent Restoration

- Functions are central to the mission of the University or impact community
- Design should minimize risk of interruption
- In case of interruption, functions should be restored or relocated on an urgent basis

A.7.1.3 Mission Support: Restoration as Possible

- Functions are part of the mission of the University
- Functions are not targeted for application of prevention resources
- In case of interruption, functions will be restored or relocated as resources are available

A.8 Goals and Objectives

§201.6(c)(3)(i)

The DRU Advisory Committee established a set of goals and objectives that provide direction to the identification and prioritization of potential pre-disaster mitigation actions.

A.8.1 Preserve life safety

- Reduce the risk of catastrophic failure in occupied spaces
- Minimize secondary hazards in occupied spaces
- Protect critical response facilities

A.8.2 Protect University assets and investments

- Reduce the risk of catastrophic failure in high value spaces
- Minimize secondary hazards to high value assets
- Protect the greater environment

A.8.3 Ensure continuity of mission critical functions

- Reduce the risk of catastrophic failure to critical infrastructure
- Minimize disruption to critical support functions
- Protect business resumption capabilities

A.9 Risk Assessment

The project team enjoyed the collaboration with representatives from the College of Engineering and the College of Architecture and Planning. Under the leadership and with the expertise of faculty, students performed much of the research required to support this project. Input was solicited and obtained from federal, state and local agencies including the U.S. Forest Service, U.S. Weather Service NORAD, USGS, Utah State Engineer's office, Utah Department of Homeland Security, FBI, various health departments and organization, and others. Also liberally accessed were the wells of information available through FEMA's own experts and databases. Finally, other academic and research units with knowledge relevant to risk assessment frequently participated in the collection of appropriate data.

Certainly, the administrative departments at the University (Finance and Accounting, Human Resources, Sponsored Projects, Facilities Management, Administrative Computing Services, to name a few) that are stewards of much of the data required for the successful completion of this project provided a tremendous amount of support. It was quickly evident that virtually all the required data exists and is available on this campus. The challenge lay more in determining where some of the data is stored and identifying the appropriate data steward.

After reviewing the list of potential catastrophic events or disasters that could befall an institution such as the University of Utah, the project team under the guidance of the DRU Advisory Committee determined that DRU strategic planning should concentrate on the following types of potential events:

- Earthquakes
- Wildfires
- Flooding and inundation
- Severe weather conditions
- Pandemics
- Terrorism and other human-caused events

Historical evidence and best current wisdom drove the decision to focus the bulk of the project's activities on earthquakes. Subsequent research and planning activities thus concentrated on this type of event, although much of the data and subsequent knowledge thus gained also supported planning activities related to other natural events. Research and planning activities related to the last two types of events, not typically considered as "natural disasters," relied on input and interactions with specialists in those areas, including health departments and experts, and law enforcement agencies.

A.10 Categorizing Mitigation Actions

Many of the activities or actions identified and described in *Section E Recommended Hazard Mitigation Actions* are already in place, or can be initiated with a reasonable level of commitment by members of the University community. A current status has thus been identified for each the items, along with a determination of its degree of criticality. Most importantly, the selection of mitigation activities is based on an institutional priority of protecting human life and safety first, followed by protection of programs, assets, and economic survivability.

The conclusions documented by the project team, after collecting input from numerous experts, stakeholders, as well as through public solicitations, place a high emphasis on the delegation of mitigation responsibilities. Therefore the full document identifies a lengthy list of pre-disaster mitigation activities for each type of event and designates each activity as one of the following:

- *Enterprise*: the institution has the responsibility for implementing and sustaining the action or activity
- *Departmental*: each department, under the authority of its dean, director, or chairperson, has the responsibility for implementing and sustaining the action or activity
- *Individual*: each person, whether student, faculty or staff has to accept individual responsibility for implementing and sustaining the action or activity.

Natural hazards such as earthquakes cannot be prevented. However, vulnerability can be eliminated or significantly reduced by building away from known seismic zones if possible, and following proper building design methodologies during new construction, or by retrofitting or demolishing existing buildings. This is an activity that lies with the University at the enterprise level, even if delegated to a specific organization such as Facilities Management. The University already adheres to current seismic design codes for this region, and has on occasion elected to exceed those codes.

For the University, site selection for the campus and many of its older buildings was determined long before the areas seismic activity was understood. At last count, approximately 210 structures on the University's current facility inventory were constructed prior to 1980, which places each of them at varying degrees of seismic risk.

The University has already had significant success in resolving seismic issues identified through a study conducted in 1991. Remaining needs are currently on a prioritized list for in-depth studies that will lead to funding requests routed through the state's capital development funding process. This is an activity, already a standard operating procedure on campus, designated as an "enterprise" level action item.

Recommended strategies at the enterprise level address specifically the opportunity to apply the data collected and the knowledge gained through this project, and merge this information into current and future campus master planning activities. Included are recommendations identifying potential funding opportunities for structural mitigation, including the funding stream for which the University becomes eligible through FEMA, once the University of Utah adopts this plan.

Proper building design and construction can help prevent collapse, but contents may still be at risk and a risk to occupants. Seismic bracing can stop equipment and shelving from falling. This is the type of activity that is best coordinated at the departmental level, with support from specialists made available by the University. This is one strategy that warrants significant attention, since it was learned that in many seismic events, more injuries and loss of property are the result of unrestrained non-structural elements than from the catastrophic failure of the building structure. A substantial number of mitigation activities recommended in the document address this issue, focusing departmental and individual responsibilities on systematically protecting non-structural elements and mitigating at risk-situations in individual workspaces.
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This document uses similar strategic approaches in identifying mitigation strategies associated with the other types of events identified in its pages: wildfire, flood and inundation, severe weather, pandemics and various human-caused events. In each of those situations, the institution as a whole has to accept certain responsibilities and take certain prophylactic actions, as do individual departments and campus occupants.

One key strategy that is pervasive among mitigation strategies addressing each of the types of events is *education*. A recommendation is offered that the University of Utah establish a high priority on providing educational programs, resources and tools, supported by succinct operating guidelines that can and will enable the implementation of departmental and individual mitigation strategies. It is typically not feasible for the University's colleges and departments to provide such resources internally, or to perform in harmony with institutional priorities if they can.

A.10.1 Additional Mitigation Considerations

Duplication of important vital records, papers, drawings and specifications is another very important mitigation strategy. Historically, universities have not placed enough effort on this type of protection. Providing guidance for records retention, etc., is a worthwhile activity to be pursued by any university. At the University of Utah, such a strategy is particularly applicable in dealing with flooding of lower levels in many of its structures. Although such flooding is extremely unlikely to occur as a result of a natural event, failures of water distribution system have occurred frequently on this campus and have caused considerable loss of important assets and records.

Protective actions, including evacuation of a building or a lockdown, require occupants to be promptly warned that there is a hazard – inside or outside – and to be told what protective action they are to take. They must also be familiar with actions and behavior they should avoid during such events. Audible alarms systems, including emergency voice and simple messaging systems can fulfill the functions of warning occupants.

The University received a critical infrastructure protection grant in 2003 which provided financial support for a security assessment of critical infrastructures. This Pre-Disaster Mitigation project, therefore, does not to delve further into critical infrastructure issues, to be addressed more effectively under the auspices of the 2003 grant. Efforts continue to identify and hire a qualified security consultant.

In the meantime, in 2007, President Michael Young appointed the Task Force on Campus Security to assess existing capabilities and recommend improvements. Reports completed by that Task Force in early 2008 recommend collaboration with other Utah higher education institutions in the selection of an emergency messaging system. The Pre-Disaster Mitigation project did not duplicate the work of the Task Force, but their findings are referenced in this document..

A.11 Future Plan Maintenance

A.11.1 Updating plan data and recommendations

§201.6(c)(4)(i)

The data used in the development of this document represents a snapshot in time. Collectively, the data represents the University of Utah as it existed during the 2007-2008 academic year. The conclusions and recommendations listed in this document are a direct result of that data. As the campus changes and grows, this data will no longer accurately reflect the true essence of the University of Utah. It follows to reason that any recommendations that flowed out of that data *may* no longer be appropriate. It is thus critical that these data sets be re-inventoried on a regular cycle, with a goal period of at least every five years. With the process and the model having been established through the current project, future planners and scribes will have little difficulty in updating this document.

A.11.2 Campus Master Planning Integration

§201.6(c)(4)(ii)

§201.6(c)(4)(iii)

The Master Planning process, now an entrenched activity at the University, is a natural host for the "Disaster Resistant University" planning process. The two processes have now been merged into one, assuring the continued support for each by the administration at the University of Utah. The Master Planning process includes significant public involvement in the form of numerous meetings, open-houses and solicitation of participation through their webiste at http://campusmasterplan.utah.edu. Public involvement in the mitigation planning process will be accomplished through these established means.

A.12 Additional Deliverables

A deliverable proposed within the grant request to FEMA identified an intention to develop a computer-based application geared to help future plan developers, whether at the University of Utah or at other institutions, as they process the tremendous amount of data required to perform the necessary risk analyses. This obligation was successfully addressed through the development of a web-based application that acts as a user-friendly front-end to computerized building inventory software available from FEMA, by building upon an assortment of open-source applications and tools. This new application is useful by allowing multiple users to enter or modify institutional data in a secure mode, whereas the FEMA application only allows local, single user access.

A short training module on CD/DVD will be made available for other institutions based on a video of a conference presentation made by DRU project leaders at CSHEMA 2009.

A.13 Conclusion

The Disaster Resistant University project (DRU) analyzes hazards and offers strategies for mitigating the effects of various forms of damaging or injury-causing events on the campus of the University of Utah. Conclusions and recommendations are based on projections of casualties and economic losses for individual buildings on campus. The DRU Mitigation Strategy provides a methodology and supporting data for the following critical activities:

1. In an earthquake scenario, the most likely of the natural threats facing this institution, more casualties occur as a result of non-structural incidents than from structural failure. The report therefore aims to establish a basis for an educational program encouraging organizational units and individuals to manage their own

respective, individual environments.

2. When analysis of a particular building is triggered by another issue – such as expansion of an academic department – the information contained in this report will be an essential factor in determining the best course of action for that project or building.

3. The Strategy will lead to the identification of certain buildings, on a priority basis, for further investigation and engineering studies, which in turn can determine the best course of action for each of those buildings, including possible replacement and the identification of the optimum funding source(s).

4. This document makes available information that identifies critical programs or functions that are located in at-risk locations, extending the opportunity for incorporating such knowledge into current and future strategic planning activities.

5. Other types of events can also befall the institution, its population, and its assets. Though of a less significant risk level, those events also need to be considered in current and future planning activities at the institution.

B. <u>Introduction</u>

> *"If it is the necessity of the young to challenge and risk, it is the obligation of the old to conserve, not only for their own sake but for the sake of the young who at the moment want anything rather than conservation. No society is healthy without both the will to create anew and the will to save the best of the old; it is not the triumph of either tendency, but the constant, elastic tension between the two that should be called our great tradition."*(Wallace Stegner, "The Book and the Great Community," as quoted in "The University of Utah, 150 Years of Excellence, by Craig Denton)

B.1 Foreword

In 2005, the University of Utah was awarded a Disaster Resistant University (DRU) grant under the Pre-Disaster Mitigation Grant Program administered by the Federal Emergency Management Agency (FEMA). The Pre-Disaster Mitigation (PDM) program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. The grant provided the funding necessary for three major accomplishments: the development of a mitigation strategy at/for the University of Utah; raising risk awareness throughout the University; producing a user-friendly mitigation planning tool for potential use by any type of community.

A plan is a proposed or intended method of getting from one set of circumstances to another. Plans are often used to move from the present situation, towards the achievement of one or more objectives or goals. Involving a team in its development and benchmarking with others allows authors to avoid making determinations based on inadequate information. This certainly was in itself a risk that the DRU project managers at the University of Utah were determined to avoid.

All universities are subject to natural and human-caused hazards that threaten life and health and cause significant property damage. An interdisciplinary research team at the University of Utah undertook this DRU project to better understand these hazards in the context of today's campus environment generally, their impacts on the University of Utah as a component of its surrounding community, and as a means of identifying ways to reduce those impacts. As implied in the original award, a deliverable of the project was also to update an unspecified component of FEMA's DRU approach to mitigation that would prove beneficial to other campuses with major health sciences and research enterprises.

To better understand the range of hazards facing higher education and to validate assumptions regarding process updates that would be value-added, the University of Utah DRU team planned to benchmark with two peer institutions. Clearly the most significant hazard for the University of Utah campus is seismic activities. Utah experiences approximately 700 earthquakes a year. The campus of the University of Utah is located within one-tenth of a mile from the active Wasatch Fault. The University of California, Berkeley certainly qualified as one peer institution because of its seismic similarity to Utah and because of its recent history of success with mitigation grants. It also has a significant research component, like the University of Utah. UC-Berkeley is the current national leader in pre-disaster mitigation in a seismically active region. The Universityof Utah therefore sent a small delegation to visit with counterparts at UC-Berkeley.

The University of Utah has a twenty year history of construction activities related to mitigation of potential earthquake losses. In 1989, the University of Utah commissioned an in-depth seismic study of existing buildings. The final report identified and categorized structural deficiencies and informed capitol construction decisoin-making for multiple, consecutive administrations.

In order for this mitigation strategy to be value-added, it needs to support all hazards. The University of North Carolina was originally our second benchmarking target specifically because they were vulnerable to a hazard we clearly are not: hurricanes. However, before we could make our arrangements, Hurricane Katrina came ashore along the Gulf Coast interrupting operations at a FEMA DRU campus: the University of New Orleans. Additionally, Hurricane Katrina significantly impacted a peer research institution (Louisiana State University) and a peer health science campus (Tulane University). There was no better learning environment for the project at the University of Utah. Accordingly, a team traveled to LSU, UNO, and Tulane one year after Hurricane Katrina. Several members of the DRU Advisory Committee also participated in this fact-finding tour.

Findings from both of these excursions are summarized in Appendix H.7: Field Trip Observations.

B.2 Our Planning Process

"… I've always found plans are useless, but planning is invaluable."

– Dwight D. Eisenhower

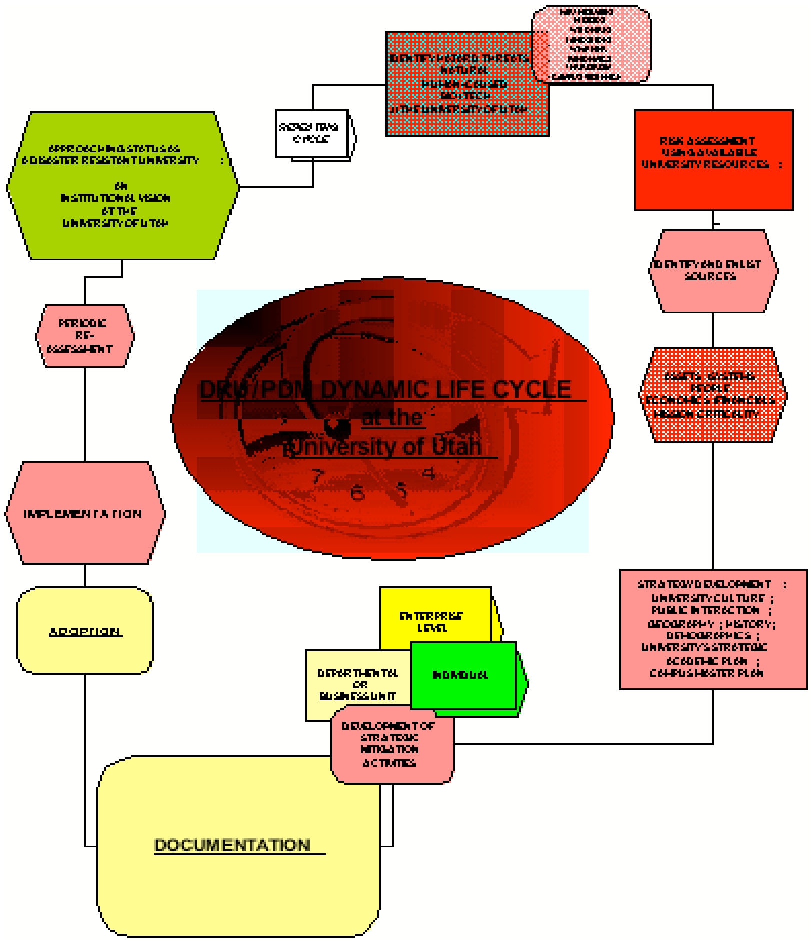

Figure 1: Planning cycle

The preceding graphic clarifies the repetitive life cycle of pre-disaster mitigation planning at the University of Utah. It intentionally does not present a "start" point, since the entire process is designed to be continuous and uninterrupted. For clarity of understanding in this presentation, the pink box at the top of the graphic will be the starting point and the discussion will progress clockwise from there.

B.2.1 Steps in the Planning Cycle

B.2.1.1 Identify Hazards

Planners at the University have and will continually identify natural and human hazards that pose a risk to the campus community. The risks associated with natural disasters may change as the University implements appropriate mitigation actions and strategies. The risks associated with human caused activities merit particular attention in the future, as the nature of society changes.

Currently, the hazards identified in the next box have been included in the assessments documented in this Plan. This could change in future revisions of this document.

B.2.1.2 Risk Assessment

As academic strategies and research programs change at the University, so will the resources that planners will have to rely upon change from those that were so beneficial during this first cycle.

B.2.1.3 Identify and enlist resources

Specific contacts will and data stewards also change over time, and will have to be re-identified and enlisted in future cycles.

B.2.1.4 Assets/Systems

The most dynamic aspect of a university community, particularly one that is as heavily focused on research and health care as the University of Utah, is the make-up of its assets and liabilities. As was done during this first cycle, future updates of this Plan will have to update inventories of populations, physical assets and their pertinent characteristics, and economic implications. Equally important is and will be an objective assessment of the mission criticality of programs and assets, as priorities for the implementation of mitigation strategies are established.

B.2.1.5 Strategy Development

Designing and adopting a pre-disaster mitigation plan at the University of Utah, with an extremely diverse population with equally diverse priorities, is most likely to be successful when stakeholders and interested parties have numerous opportunities for interacting with planners and for offering feedback regarding the results of the process. The consensus among planners and stakeholders is that this is likely one of the most critical stages of the DRU planning process. Meetings targeted at stakeholder groups opened the door for lively discussions and exchanges of ideas. Additional opportunities for such exchanges, which certainly should be exploited again in future iterations of the planning process, include the publication of relevant articles in various campus publications promoting and reviewing activities related to the plan's evolution, encouraging public input.

B.2.1.6 Development of Strategic Mitigation Activities

The approach used in the development of the Plan identifies mitigation activities, tempered by public input derived in the preceding phase, that are designed to reduce the risks associated with potential events. These are subsequently assigned to key role players who will "own" the responsibility to cause the implementation of each strategy.

B.2.1.7 Documentation

This is a continuous function, evolving and occurring during the entire planning cycle. The location of this particular box in the graph indicates that it is only at this stage that the entire documentation process for the current cycle comes to closure, is folded into a single document for presentation to senior leadership at the institution.

B.2.1.8 Adoption

At the University of Utah, the president and the cabinet of vice presidents and other senior leaders have the obligation to assess the value and intent of the Plan, ultimately deciding its fate regarding adoption and implementation. When adopted, the Plan is submitted to the Utah State Office for Homeland Security, and ultimately to FEMA/Denver for final acceptance. Informal reviews by these various entities may occur during the development process.

B.2.1.9 Implementation

The current version of the Plan makes certain recommendations intended to facilitate its implementation. It is only after its adoption by the University's leadership that formal implementation can commence although throughout the document evidence is offered that a significant number of activities are already in process. A significant portion of this implementation phase is already in place through the incorporation of this process and the Plan into the Master Planning process that re-occurs on a regular basis.

B.2.1.10 Re-Assessment

This Plan is based on a "snap-shot" of characteristics at the University in a moment of time. To remain valid and credible, the details supporting the Plan's development must be re-assessed with the most current data constantly providing a solid

foundation for the Plan. Its incorporation into the Master Planning process provides the basis and encouragement for this process to occur on a regular basis.
The cycle continues and evolves into a Plan that is constantly improving guiding the way for the University of Utah toward becoming a disaster resistant university.

The DRU project management team at the University of Utah followed the phases of FEMA's Mitigation Planning Process with minor adaptations, as will become apparent in subsequent sections.

B.2.2 Organizing Resources

B.2.2.1 Acknowledgement of Plan Participants

Primary guidance in the development of this strategic document is the result of efforts by the DRU Advisory Committee. The wisdom and guidance of these dedicated individuals were readily and frequently provided during the deliberations occurring at each of the quarterly meetings in which they participated, commencing with the first meeting held in the fall of 2006.

The following individuals accepted appointments to the Advisory Committee in August, 2006:

Wayne McCormack, Professor, College of Law and Committee Chairman
John Ashton, Executive Director of the Alumni Association
Jerry L. Basford, Assistant Vice President for Student Affairs
Richard B. Brown, Dean of College of Engineering
Norm Chambers, Assistant Vice President for Auxiliary Services
Charles Evans, Director of Research Park and University Land Manager
Sarah George, Director of the Utah Museum of Natural History
Phil Johnson, Associate Vice President for Human Resources
Basim Motiwala, Vice President, Associated Students of the University of Utah
Steve Panish, Assistant Vice President, Health Sciences, Strategic Planning
Mike Perez, Associate Vice President, Facilities Management
Ron Pugmire, Associate Vice President for Research
Patti Ross, Special Assistant to the Senior Vice President for Academic Affairs
Brenda Scheer, Dean of the College of Architecture and Planning
Laura Snow, Special Assistant to the President

Bradley Bartholomew, State Office of Emergency Planning
Doug Bausch, FEMA Region VIII Office
Tony Mendes, FEMA Region VIII Office
Mike Stever, Salt Lake City Office for Emergency Planning

Alternates:

Nancy Barr, State Office of Emergency Planning
Eric Browning, Facilities Planner, Facilities Management
Kara J. Hurst, Registrar, Utah Museum of Natural History

In addition to this committee's quarterly meetings, one or more members of the Planning team participated in interviews and/or discussions as described Appendix I

B.2.2.2 Administration Organizational Chart

The organizational structure of the University of Utah, though unique in the details, is quite similar to that of other research universities: very complex. Assigning responsibility for the tracking or accomplishment of the mitigation actions is therefore, of necessity, equally complex.

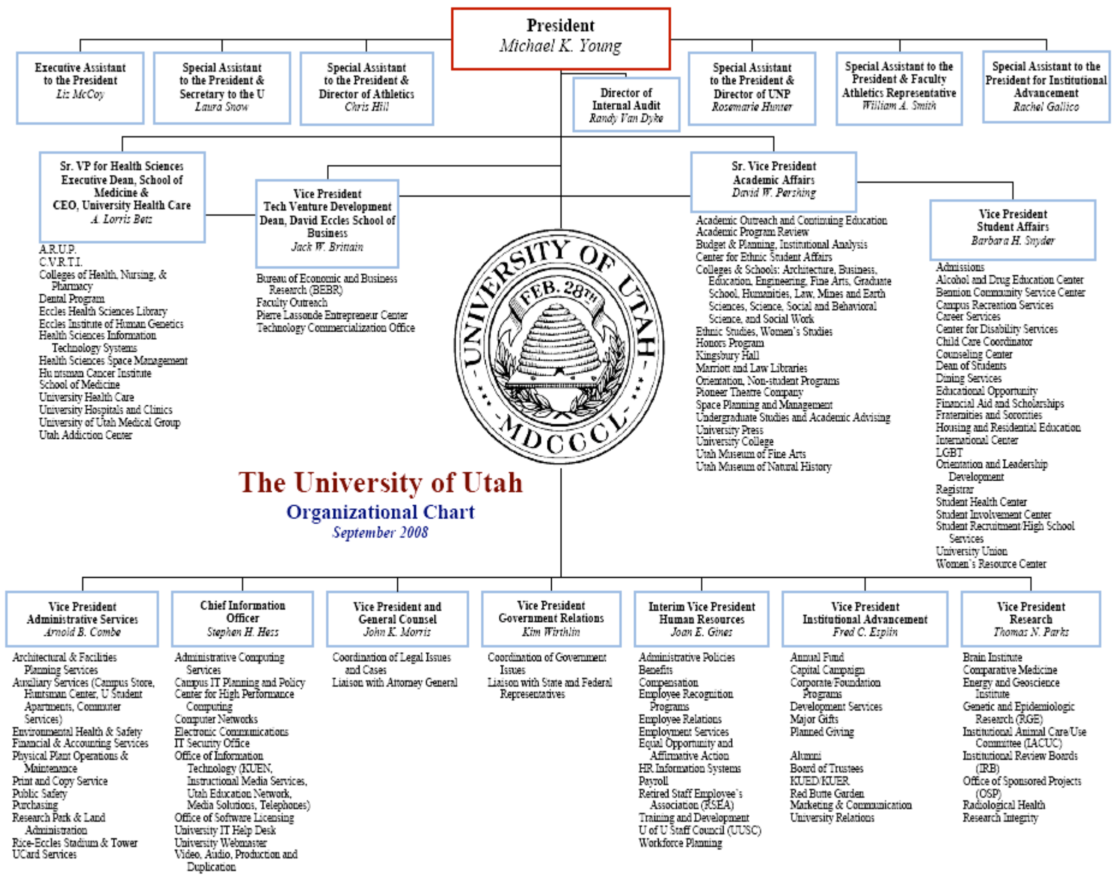

Figure 2: University of Utah Organizational Chart

The University Officer for whom the development of this document is intended provide the most support is Sr. Vice President for Academic Affairs, Dr. David Pershing. His office provides day-to-day leadership for much of the campus community, as delegated by President Michael K. Young.

Each of the individuals listed on the President's organization chart has primary accountability for activities identified at the departmental or individual level, in her/his area of responsibility. However, many of the support activities required for the effective implementation of these sets of activities will emanate from the division of Administrative Services, without any direct authority except as delegated by the university's president.

In addition to those support activities, the primary accountability for the monitoring and implementation of enterprise level strategies, described below, resides with the office of the Vice President for Administrative Services, who has direct authority over the units identified in the following organizational chart.

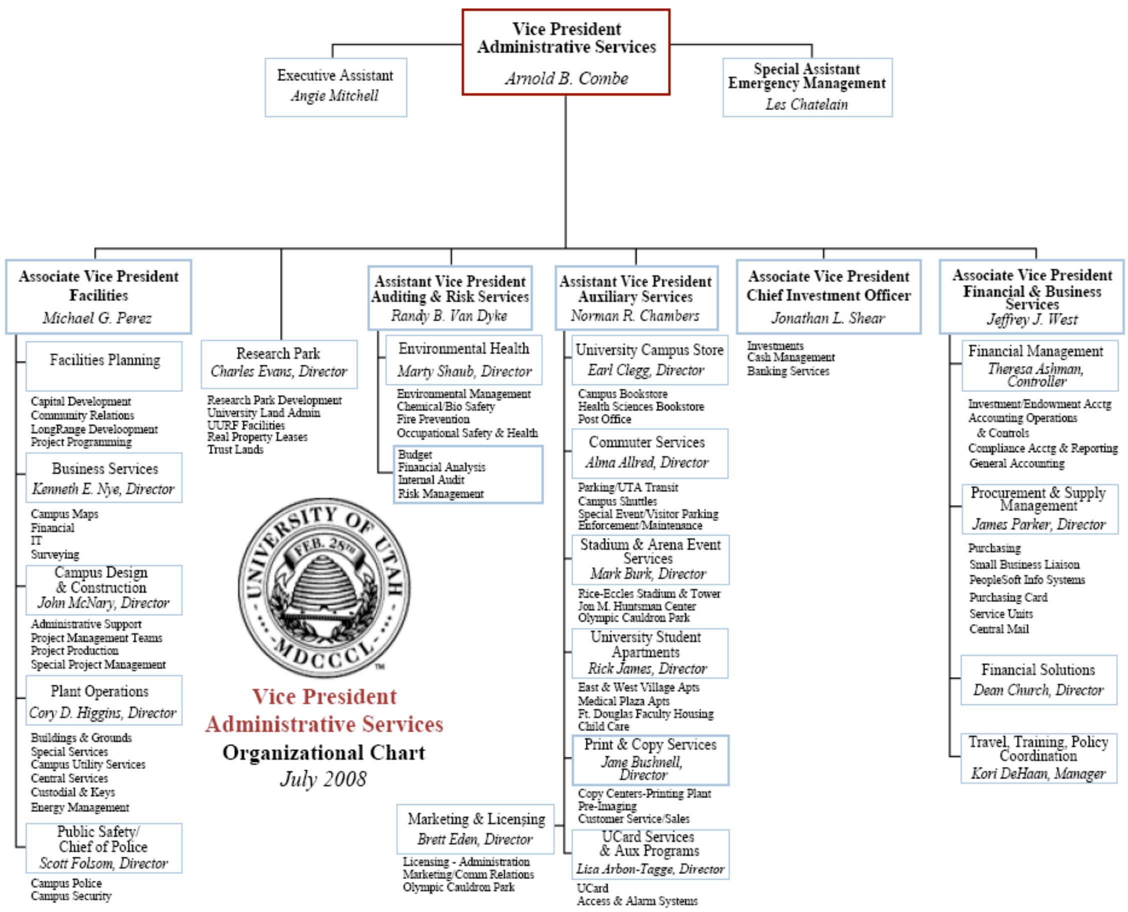

Figure 3: Vice President of Administrative Services Organizational Chart

The division of Administrative Services includes several departments or individuals that will have impact on the success of most of the following strategic mitigation actions. These are:

Table 1: Primary administrative positions for mitigation efforts

Position Title	**DRU-related functions**	**Current Incumbent**
Special Assistant for Emergency Management	Oversight of preparations for a campus Emergency Operations Center and associated training.	Les Chatelain
Associate Vice President for Facilities	Planning, design, construction of remodeling, upgrades and new construction	Michael G. Perez
Director Plant Operations		Corry Higgins
Director Campus Design and Construction		John McNary
Public Safety/ University Police Chief	Law Enforcement; security	Scott Folsom
Assistant Vice President for Auditing and Risk Services	Internal Audit	Randy B. VanDyke
Director, Environmental Health and Safety	Occupational and environmental health and safety programs, development of emergency operations plans and mitigation plan development	Marty Shaub
Manager, Risk	Insurance	Jerry Allred

Additional university administrators who will play a significant role of a more secondary nature in the acceptance and implementation of proposed mitigation actions are:

Table 2: Secondary administrative positions for mitigation efforts

Assistant Vice President, Auxiliary Services	Commuter Services, Transportation, Triage and Staging, Residential	Norman R. Chambers
Associate Vice President for Financial & Business Services	Purchasing, Accounting	Jeffrey J. West
Vice President, Human Resources	Human Resources, Policy and Procedures	Joan Gines, Interim.
Vice President and General Counsel	Legal Issues and Advisor to the President	John K. Morris

Suggestions for individual accountability for specific mitigation actions are included in Section E: Recommended Hazard Mitigation Actions.

B.2.3 Understanding Risk and Assessing Vulnerability

B.2.3.1 Summary of Hazards and Mitigation Actions

B.2.3.1(a) Natural Hazards

The DRU Strategy assesses the impacts of hazards associated with catastrophic earthquakes, pandemic flue, landslide, flood, severe weather, and wildfire. Several of those potential hazards present a higher level of potential threat to the University than do some others. The document will address each of those threats, albeit to varying degrees of exploration.

The conclusion reached through the research and planning process identifies three potential natural disasters that present a more significant degree of threat to the University than do the others: floods, wildfires, and earthquakes. Therefore, the most detailed research and discussion reflected in this document focus on those three types of events. Predictably, the most comprehensive analysis is heavily concentrated on circumstances surrounding a major seismic event.

B.2.3.1(b) Terrorism and other Human-Caused Events

The political environment in today's world has produced a significant increase in politically related violence. Terrorist activity has evolved, becoming a more pronounced, dramatic method to deliver a political message. While international events have captured headlines, there is reason to believe that international, domestic and "lone wolf" activists and plotters continue to increase their interest in domestic targets.

Other "human" events, such as pandemics, also pose a potential threat to the population and welfare of the University of Utah. That type of event also receives appropriate discussion in this document.

B.2.4 Developing Mitigation Strategy

Recommendations for mitigation strategies that are applicable at the University of Utah have been developed for three different levels: Enterprise level, department level, and individual level.

B.2.5 Implementing Mitigation Strategy

B.2.5.1 Adoption and Implementation

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Complex organizations may plod through extensive planning projects, only to develop an impressive document that may never again see the time of day. To prevent this fate from befalling the DRU Strategy at the University of Utah, the contents of this document will be required to progress through a comprehensive approval process.

As mentioned earlier, one significant accomplishment is the successful marriage of DRU Strategic document to the University of Utah's Campus Master Plan available at http://campusmasterplan.utah.edu/index.html. Each of these plans needs the other, and either one will lose effectiveness if the other one ceases to exist, or becomes meaningless. The two strategies will exist as one as they progress through the final stages of the approval and adoption process at the University of Utah.

B.2.5.1(a) Approval by the Advisory Committee

The Advisory Committee appointed by Senior Vice President Pershing has to approve the DRU Strategy, since senior administrators place a high value on the committee's input and endorsement.

B.2.5.1(b) Review by the Office of General Counsel

The Plan will have to undergo scrutiny by the University's General Counsel. Their role will be to insure that this document does not inadvertently obligate the institution to undesirable commitments.

B.3 History of Mitigation at the University of Utah

The University of Utah has already demonstrated a history of commitment to pre-event or pre-disaster mitigation, through words and actions. The following highlights illustrate that commitment.

- The University has regularly, for decades, hosted opportunities for faculty, students, and staff to receive prophylactic flu shots— free of charge.
- The Department of Environmental Health and Safety has long seen as one of its primary missions the education of faculty, students, and staff in understanding and practicing safe behavior. Its representatives are in frequent contact with

departmental representatives across the campus to help establish protocols and performance measure that will support this objective.

- In an effort to help combat the spread of AIDS and the HIV virus, the University of Utah installed condom vending machines on its campus. This program was discontinued a few years ago due to a lack of utilization.

- In situations where damage caused by unanticipated events did occur, the University has implemented measures that would reduce the likelihood of such damage occurring again, in anticipation of possible repeat situations. For instance:
    - After a city-owned aqueduct that traverses the campus ruptured (1962), and the University's primary data center was inundated, improvements were implemented that would not allow the inundation of that center again. This was achieved through the provision of raised floors, moisture detectors, additional barriers, and negotiations with SLC aiming to eliminate use of the aqueduct.
    - The overhead distribution system that historically provided electricity to most of the campus was extremely unreliable. The University implemented a systematic program of moving those systems and associated equipment underground, making them significantly less vulnerable to failure due to extreme weather conditions and sabotage.
    - In anticipation of domestic terrorism or even the occasional malcontent inspired to do harm, the University invested in devices that restricts access to utility manholes and tunnels.
    - Similarly, the University constructed a secure hazardous waste facility that is designed to provide a secure transfer station for hazardous and radioactive waste.
    - Currently, the University is developing a strategy aiming to place much of its 18 mile high pressure, high temperature hot water (HTHW) distribution systems into secured tunnels. The University recognizes that there is a risk to pedestrians, in particular, every time a rupture occurs in one of these aging lines. The University is also working closely with the State of Utah to develop a funding plan for replacement of most of this direct-bury HTHW distribution system,

- For decades, the University's construction standards have met or exceeded existing design and construction codes and requirements. This strategy was not prompted by any kinds of catastrophic events.

- The University of Utah, in partnership with the State Division of Facilities Construction and Management (DFCM) and the Utah State Building Board, has for many years had an annually funded capital improvement program that allows the institution to identify and address areas of vulnerability with buildings, systems, and components. Accordingly, the University has been able to mitigate challenges ranging from bad roofs to inadequate research fume hoods, and CFC chillers to fire notification system upgrades.

- Understanding that its existing facilities in 1988 fell short of current seismic design standards, Mr. Walt P. Gnemi (then Vice President for Administrative Services) commissioned an in-depth study of existing buildings, identifying the risks and vulnerabilities associated with those buildings. That study led the way to a program of systematic renovation of numerous “historic” buildings on the campus, along with the removal of others. (See Appendix H.5.1)

  Most of the buildings located on or around historical Presidents’ Circle have been refurbished, with the remaining ones targeted for such renovations in the future. Buildings at risk such as the “Old Gym,” several of the old dormitory buildings, and numerous WWII vintage buildings have been demolished. Reinforced by the results of the DRU/PDM project, other buildings are currently on the list for demolition as well, only awaiting the funding and opportunity to do so.

- The old Rice Football stadium, built in the 1930’s, was a mostly wood structure. The University, recognizing the risk, placed a high emphasis on its renovation or replacement. This project was completed in 1998. The new Rice-Eccles Stadium subsequently provided a well-designed and safe structure for the Opening and Closing Ceremonies of the 2002 Winter Olympic Games and is currently the site for University home football games and other events.

- More recently, the 40-year old Marriott Library underwent an extremely significant seismic retrofit and programmatic update. Project planners recognized that the structure had originally been under-designed from a seismic perspective, and determined that programmatic upgrades to the facility should only occur if seismic upgrades were simultaneously addressed. FEMA concurred, and contributed $3,000,000 in support of this project.

- Anticipating the likelihood of pandemic situations, the University has long been committed to a discovery and training process. The goal is to prepare the institution and its decision makers for the eventuality of the arrival of the communicable H5N1 or Avian Flu virus, in terms of preparation, training, as well as response. The University established a task force in 2004 that continues to meet. Representatives from various key sectors of campus participate in its deliberations, with a significant representation from the Health Sciences and University Hospital arenas. This group interacts very closely with County and State health officials, and representatives from other area hospitals.

- The number of incidents of rape and violent assaults on college campuses is increasing. One characteristic that plagues some campuses is inadequate site lighting for its after-dark population. Such inadequacies can be the result of inadequate funding or low priorities, poor design or outdated systems, or poor maintenance. The University of Utah has identified programs and priorities aimed at maintaining a high level of safety for its population at all times. In recognizing that even well illuminated parts of campus may provide a setting for would-be perpetrators, the University long ago established an "escort" service. This feature provides additional safety as pedestrians make their way to their cars or mass transit stops.

- More than 20 years ago, the University recognized the need for emergency phones across the grounds and parking lots of this large campus. This investment has provided a sense of safety and security for campus stakeholders. Fortunately, to date, the primary use of these facilities has been by individuals with health issues such as a heart attack. Although the large number of personal cell phones has reduced the demand for emergency communication stations, the University remains committed to the provision of additional units, where deemed essential.

- During preparations for the 2002 Winter Olympic Games, the University recognized the need to secure many of its facilities and to protect some of its critical functions and programs. In collaboration with state and federal agencies, this process was implemented and in place months before the arrival of the athletes and dignitaries. Fortunately, much of the knowledge and procedural enhancements remain in place today.

- In response to an increasing number of shootings on college campuses, the University of Utah established a task force assigned with the responsibility for identifying protocols to reduce risk, identify potentially explosive situations, and develop mass warning and communication technologies appropriate to each situation. The University of Utah Police Department is in close collaboration with local, state and federal agencies to monitor and plan preventive strategies as appropriate. Of particular interest for the University of Utah are the so-called "eco-terrorist" and "animal rights" groups.

Clearly, the development of this Pre-Disaster Mitigation Strategy is yet another huge step for the University of Utah in becoming a *Disaster Resistant University*.

B.4 Mitigation Planning in 2008 and Onward

The DRU Advisory Committee provided statements of vision, mission, strategy, goals and objectives that guided the development of current strategies. These same sets of core values will drive future pre-disaster mitigation strategic planning processes. A substantial amount of effort will continue to be dedicated to the mitigation of challenges associated with seismic events.

B.4.1 Communication and Education

Populations tend to be relatively naïve on the likelihood and potential impact of natural disasters in their own environments—until they have recently experienced one. The population at the University of Utah , with few exceptions, has not experienced a significant disaster. In many, this has perpetuated an apethy that can become an obstacle in the mitigation planning activities and the successful implementation of pre-disaster mitigation actions. One long term objective, and admittely a major achievement, will be to develop a process that will successfully provide incentives and emphasize educational opportunities and other "toolkits" designed to maintain relevant communications, to develop understanding, to stimulate action, and to assess the results.

B.4.2 Non-Structural PDM actions

A significant level of risk is associated with non-structural elements, as opposed to the total failure of existing buildings. The mitigation of some of these situations on existing buildings, such as weak parapets, unconstrained rooftop mechanical equipment, and similar conditions is best coordinated at an institutional level by an organization such as Facilities Management. This protocol is already in place. Similarly, a protocol is in place to insure effective design and construction of new facilities.

Research into the impact of past events elsewhere, as well as an analysis at the University of Utah indicates that conditions in individuals' own work spaces can become a leading contributor to injury or loss of property. The University may therefore elect to place the responsibility for the implementation of pre-disaster mitigation actions intended to aleve those conditions where such actions will provide the most effective results: at an individual and/or a department level. Even as a central review of conditions should be considered, much of the authority should be placed with department heads and supervisors.

B.4.3 Structural PDM actions

B.4.3.1 <u>Planned seismic analyses through existing Capital Improvement</u>

The University of Utah's FY2009 Capital Improvement list, prepared in mid-2008, identifies five existing buildings on which the University wants to perform

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additional seismic impact analyses. The inclusion of buildings on this list was determined largely by the information and criteria generated through this DRU process. It is hoped that the 2009 State Legislature will make available the expected funding pool by mid-March, 2009. Once those funds are in place, the University will authorize building specific engineering studies that will identify appropriate pre-disaster mitigation actions. The research that has already been performed through this project will provided the foundation for those studies.

B.4.3.2 Future Capital Improvement funding opportunities

The University intends to repeat and apply this protocol during future cycles of the Capital Improvement funding process. For the implementation of structural remedies with budgets exceeding $3 million, officials at the University will examine its remaining funding opportunities. Quite typically, this may require the solicitation of funding through the Capital Development process. This protocol is already established, and will accommodate requests initiated from this direction—in competion with other capital needs at the University.

B.4.3.3 Historic preservation considerations

Mitigation may involve the removal of buildings that do not provide a reasonable return on investment for mitigation. It is possible that such removal may require prior approval from the State Historical Preservation Officer (SHPO), if a building is on a historical list or is in a historical district—a distinct possiblity at the University of Utah. Such an option will have to be carefully planned out and implemented. The responsibility for such collaboration with typically fall with Facilities Management.

B.4.4 Long Term PDM Strategies

Immediate implementation of some of the most desireable, high priority, but costly PDM actions is not an option. The University intends to identify alternate solutions to resolve situations that are truly in need of short-term attention, as may resonate throughout this document. Based on the models developed through this process, and (if necessary) after further study, a recommendation may evolve to relocate certain activities to locations that are less at-risk. Such determinations will require collaborative planning among several departments, such as Facilities Management, Space Planning and Management, Risk Management, Environmental Health and Safety, and others contingent on individual situations.

The University of Utah has incorporated the DRU Strategy into its long range, campus planning process. This will insure that decisions made in the future regarding space, facilities, and systems will take into consideration pre-disaster mitigation needs and priorities. It will also insure that, as the master plan is updated on an anticipated five years cycle, so will the DRU documents and related data.

B.4.4.1 Business Recovery as a PDM Strategy Component

The PDM planning process must remain sensitive to a unit's (and the University's) need and ability to recover in a post-event situation. Collectively, such plans should address the need for successful business continuity or at least an acceptable rate of recovery, as determined by the "mission criticality" of a function. The "mission criticality" parameters (discussed in A.7.1 Defining Criteria) developed by the DRU Advisory Committee helped guide the determinations identified throughout this document.

B.4.4.2 Academics

At any university, a primary consideration for business recovery is the need to resume academic activities. There should be a high priority placed on the need to establish appropriate redundancies of student-related data files, as well as security and signature files. If the primary IT support facility is at risk, it is necessary to make arrangements for off-site locations. Senior officers at the University of Utah have already implemented a plan that will help address and mitigate this type of issue in case of a catastrophic event. However, future mitigation planning activities may strive to reduce the risk of failure or interruption at primary locations, by exercising one or more of several options: relocation, enhancement of existing facilities, or other.

B.4.4.3 Research

Case studies indicate that, in a post-event situation, research activities can frequently be resumed at alternate locations, *if prior arrangements were made*. PDM planners at the University of Utah strive to make researchers aware of vulnerabilities and risks in their specific situations. They will have the opportunity to arrange for alternate sites that can provide a temporary base for continued operations. Researchers must also be encouraged to maintain reliable and redundant records of their activities. This will be a multi-faceted effort, involving the Office of Sponsored Projects, Risk Management, Environmental Health & Safety, and others. The primary responsibility should reside with the appropriate dean and/or department chair.

B.4.4.4 Support functions

Certain functions may be challenged to survive significant business interruptions of 30 days, 60 days, or longer. The leadership of those functions must feel encouraged to identify alternate ways of assuring acceptable continuity. Unless pre-event arrangements were made, it is not likely that alternate sites, equipment or other resources will be readily available on (or anywhere close to) the campus of the University of Utah. Responsible administrators will need to ferret out such alternate resources prior to an event, and develop appropriate MOUs (Memorandum of Understanding).

B.4.4.5 Patient Care and Health Sciences

Hospitals and other patient care facilities have a long tradition of planning for emergencies and disasters. University Hospital is certainly no exception, where officials have developed such emergency planning and response plans in collaboration with other entities on and off campus. They have communication plans in place with other patient care facilities, both in close proximity and further removed.

Future planning activities for the entire institution should continue to address "life lines" serving the Health Sciences campus, including transportation and essential utilities—emphases not addressed by activities that led to the development of this document. Such planning activities should be coordinated through Facilities Management, in collaboration with Health Sciences, University Police, Environmental Health & Safety, Commuter Services, among others.

B.4.4.6 Future Planning Commitments

In order to enable future successes associated with a Disaster Resistant University, this Strategy assumes that the University will seriously consider the adoption of the following strategic positions:

1. Provide visible, clear, consistent and continuous support on behalf of DRU and the PDM process from senior administration, re-articulated on a regular and frequent basis,
2. Provide a clear designation indicating the office or individual who "owns" the DRU Strategy as well as the responsibility for the coordination of continuous DRU planning processes and implementations,
3. Authorize and appoint a DRU Advisory Committee with representatives from key areas of the institution (i.e. health sciences, academics, research, student life, support, facilities, etc.), whose membership, terms, and authorities are consistent with other advisory committees already a tradition at the University of Utah

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B.5 Official Record of 2009 Adoption

This document, reflecting the strategies to be employed by the University of Utah as it progresses to becoming a Disaster Resistant University, has been reviewed and adopted by the following groups or individuals, as indicated:

DRU Advisory Committee:

Signed: ______________________ Date: 9/22/2009
Wayne McCormack, Chair

University of Utah Board of Trustees:

Conceptual Adoption on: JUN 0 9 2008 ______________________, 2009

Officers of the University of Utah:

Signed: ______________________ Date: 9/22/2009
Martha D. Shaub, Project Director
Director, Environmental Health & Safety

Signed: ______________________ Date: 9/22/2009
Arnold B. Combe
Vice President for Administrative Services

Signed: ______________________ Date: 9/22/2009
David W. Pershing
Senior Vice President, Academic Affairs

(and/or)

Signed: ______________________ Date: 9/22/2009
A. Lorris Betz
Senior Vice President, Health Sciences

(and/or)

Signed: ______________________ Date: 9/24/2009
Michael K. Young
President, University of Utah

C. Campus Profile

C.1 History

The University of Utah was founded February 28, 1850 in downtown Salt Lake City. After having been closed down for a period due to lack of funding, it reopened at its current location late in the 19th century.

The area known today as Presidents' Circle was the original center of the campus. Buildings still located in this area were constructed early in the 20th century. Many other buildings dating back to those early years had already been eliminated or replaced before World War II. As might be expected, these buildings are almost entirely un-reinforced masonry. At this writing, approximately two dozen of those original buildings are still in use on the main campus, including several WWII wood-frame vintage barrack-type buildings whose ownership was transferred to the University at various times after WWII.

The GI Bill (also known as the Servicemen's Readjustment Act of 1944, PL345) had a radical impact on the nature and availability of higher education. In anticipation of the end of WWII, the federal government offered the opportunity for a continued education to the veterans who would soon be coming home. With them came the realistic probability that unemployment rates could be dangerously high.

At the University of Utah, this Strategy resulted in a land transfer from the military, as it began to downsize Fort Douglas, which until this time had possession of most of the real estate east of the original campus. The eastern boundary of the campus, previously located at approximately 1500 East, moved uphill through fields previously used for cavalry drills and artillery practice, into the foothills to the east of the campus. Ownership of the Fort Douglas affiliated golf course (once touted as a top PGA course) was also transferred to the University at this time.

As an intended result of the GI Bill the first major building boom occurred shortly after the acquisition of this additional land. This was the first significant expansion of space in nearly fifty years. Buildings such as the Student Union, Orson Spencer Hall, and Ballif Hall were among the first buildings to be constructed during this period. State funding for new buildings flowed relatively freely during this period. (It must be said that funding for the renovation of existing buildings was extremely difficult to obtain during these years.)

One of the first significant buildings to be constructed on the extreme eastern edge of campus was the University Hospital (Bldg. 521) which would adopt all activities and programs associated with the old county hospital, then located on the north-east corner of

State Street and 21st South, in Salt Lake City. By the early 1980s, Bldg. 521 became the dedicated home of the School of Medicine, as patient care facilities mostly moved into the then-new University Hospital (Bldg. 525).

As the number of students grew, so did the physical campus, mostly along the corridor that might today be considered the north-south axis of the main campus. This growth continued at an astounding rate through the 1960s into the 70s, when it temporarily slowed down. Another building cycle took off in the 1980s, and still continues today, seemingly growing more rapidly than ever. One notable change in planning and construction is that more of the funding for new construction comes from non-state sources than had historically been the case. Another change is that the State has become more willing to fund needed building renovations and upgrades.

In 1991, the University gained ownership of an additional plot of land, approximately 55 acres, as more Fort Douglas real estate was re-appropriated. Along with that land came the ownership and stewardship over several dozen historical buildings that are mostly residential in nature. Since many of these units were constructed in the 19th century, they came with accountability for their continued existence that is closely monitored by the Secretary of the Interior and the Utah State Historical Preservation Office. An additional 12 acres was transferred in 2000, in time for the University to proceed with construction of the final phases of its new living/learning center, a student residential community designed to double as the Athletes Village during the 2002 Olympic Winter Games.

The University of Utah (first known as the University of Deseret) began its existence as a “normal” school, with a heavy focus on developing teachers. As time progressed, medical education as well as law, engineering, behavioral sciences and numerous other academic curricula sprouted up across the academic horizon of the University. Today, there are 18 colleges accepting students at the University.

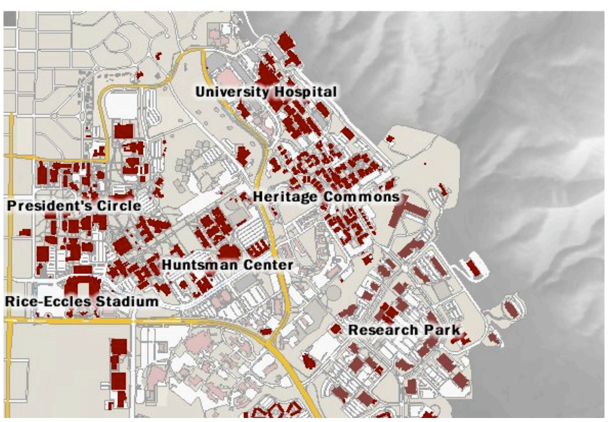
For the last fifty years, there has been an increasing emphasis on intense research--in many different arenas. Today, the University of Utah is a Research I institution, placing it among the top fifty research institutions in the country. It is renowned for its research activities in human genetics and cancer, as well as computer and information technology, engineering, biology, physics, and other related fields. All indications are that, even as the University strives to attract and retain a broader base of new students, the amount of research occurring on this campus will continue to increase, bringing with it the need for sustenance and construction of appropriate spaces. At least in part, this is evidenced by the 2006 Senate Bill 75 titled the *Utah Science Technology and Research initiative* (USTAR, encouraging both new facilities and new research on the campus of the University of Utah as well as at Utah State University. “Innovation focus areas include bio-fuels, biomedical innovation, diagnostic imaging, nanotech biosensors, and personalized medicine among others.” (http://ustar.utah.gov/about/index.html)

C.2 Geography

The main campus of the University of Utah is located on the fringe of the western foothills of the Wasatch Mountains. Using world geographical coordinates, the approximate center of the campus is located at latitude: 40.7649 and longitude: -111.8460. The western edge of the campus is positioned approximately 4600 feet above sea level. This area, the oldest portion of the University on the east side of University Street, is populated with University programs and facilities. A mix of privately owned residences (single and multiple dwelling) and other activities exist on the west side of the same street. Approximately 1.2 miles east of this line is the eastern edge of the campus, rising to an average of 5050 feet above sea level. The resulting 400 foot east-to-west drop provides a setting for rapid run-off of rain and melting snow, and surprising variations in the depths of accumulating snow across the campus. As might be expected, the composition of soils also varies greatly as one travels from east to west, ranging from silty sand to solid bedrock. The shoreline of historical Lake Bonneville at approximately 5160 feet had a significant impact on the composition of soils and rocks found in this area.

The northeastern tip of campus hosts the highly urbanized Health Sciences neighborhood of the University. The southeast corner of the main campus is less developed, currently mostly sporting parking lots and a central boiler/chiller plant. The University's intent is to prohibit any further development or improvement above this eastern boundary, even though it owns a substantial amount of this property. The University has shown its commitment to this intent through the formation of the *Heritage Preserve*, prohibiting any further development. Property owners and managers (Forest Service, Central Utah Water Conservation District, Bureau of Land Management, and Salt Lake City) were involved in the development of this strategy, as were entities that hold easements and right-of-way privileges through or above the *Preserve* (Chevron Oil, Questar, Rocky Mountain Power, Salt Lake City Public Utilities).

Map 1: Campus overview



The above map highlights the major arteries of the campus. University-owned structures are represented in the darker red colors, while non-university facilities show as light pink. One of the main facilities along South Campus Drive is the Huntsman Center, a 40 year-old special events / basketball arena with an occupancy of approximately 15,000 individuals. It defines the southern edge of the main campus, and is known as Hempstead Road as it heads toward Heritage Commons. The relatively small piece of real estate east of Wasatch and south of Hempstead Road comprises a military installation, fully controlled by the Department of Defense. Despite their proximity, there is very little interaction between the Stephen A. Douglas Military Reserve (a.k.a. Fort Douglas), and the University of Utah. A recently installed security fence around the Reserve emphasizes the nature of this relationship. It is important to recall that most of the land currently associated with the University of Utah was, at some point in history, part of this military installation. Existing legislation will cause the rest of this military real estate to transfer to the University, once the Pentagon decides to "surplus" this property. At this time, there is no publicly known time line for such an event.

The only aboveground body of water on or near the campus is Red Butte Creek, which separates the Fort Douglas area from Research Park. This stream handles the run-off (rainfall as well as snow-melt) from the watershed associated with Red Butte Canyon, which opens further to the east by only a half mile. Records indicate that this Creek, once upon a time, had at least one other fork. Located further north, this minor stream was allegedly filled with trash and other fill in the 19th century by soldiers housed at Fort Douglas. There have been suggestions that the recently demolished dorms located along the historical path of this stream occasionally suffered from unusual amounts of groundwater—perhaps still following its underground path.

The Reserve is located between the University-controlled "Heritage Commons at Historical Fort Douglas" and the University Research Park, an independent corporation affiliated with the University of Utah. Title to the land was granted to the University October 1968, with actual access to the land being available after July 1, 1970. Private developers and/or corporations own and control the majority of the buildings on land leased from the University Research Park Foundation. Most of the currently existing buildings will transfer to University ownership at a contractually agreed upon, pre-determined time during the next half century. Some already have. The Research Park area falls under the jurisdiction of Salt Lake City, along with its applicable building codes (not always consistent with codes followed by the University and the State on their facilities), planning and zoning restrictions, and law enforcement.

South of Research Park is "*This is the Place*" State Park, with its many appurtenant structures. Across the street from this Park is the *Hogle Zoo*. Both these sites are very popular with residents, students, and visitors. Both of them operate under the governance of boards that are independent of each other, the University and Salt Lake City. Both entities do routinely benefit from tax revenues collected by Salt Lake County.

To the south of Research Park, and west of the "*This is the Place*" State Park, one finds University Student Apartments (a.k.a. USA). Previously known as "Married Student Housing," this community of apartments owned by the University provides a home to approximately one thousand University students and their families, one third of which date back to the 1950's era. The majority was constructed during the 1960's when seismic design was still in its infancy.

Municipal Salt Lake City surrounds the campus (including Research Park and USA) on three sides with mostly residential communities, along with a few commercial properties thrive directly west of the campus, nurtured mostly by providing services and fast food to students, faculty, and staff from the University. The Church of Jesus Christ of Latter Day Saints owns a wedge of property along the southern edge of the main campus, where it provides opportunities at religiously focused education to university students, along with other related activities. A Veterans Administration Medical Center is also located south of the main campus

C.3 Demographics

The University of Utah is mostly a commuter campus. The living/learning community at Heritage Commons and the student housing at University Student Apartments provide residential spaces opportunities for approximately 2300 students. The rest of the student population, plus all of the faculty and staff reside off-campus, commuting by various means of transportation. This may include walking, taking advantage of mass transit (bus or light rail), riding a bicycle, motorcycle, or driving a vehicle. There is only moderate use of carpools. Increasing numbers of individuals are taking advantage of more economical ways to commute; especially as fuel prices and parking costs on campus are on the increase.

Estimates suggest that, during a normal work and school day with no special events, up to 50,000 individuals spend time on campus (excluding Research Park, but including patient care and visitor traffic to the hospitals located on campus). The vast majority of this group of individuals adjourns from the campus by 6 p.m. every day. In the evenings during the workweek, the total number of individuals at the hospitals remains relatively constant, while the academic community shrinks to less than 20% of its daytime load--the University of Utah supports a fairly intensive nighttime and summer academic schedule. While the research community also decreases in campus population at times, it is quite common for research laboratories to have one or more occupants overnight and on weekends

The University of Utah is one of the largest employers in the State of Utah. On the average, there are approximately 2700 faculty and 14000 staff (excluding students) at this institution on any given weekday.

The University Guest House, a small University-owned hotel located in the Heritage Commons area, is open every day of the year. During the summer months, the student life area and residences are heavily and frequently populated by individuals (often of high school age or younger) participating specialized “summer camps” conducted at, though not necessarily by, the University of Utah. The University encourages such activities, in part as an effort to reach out to potential future students.

Demographics specific to students rolls out as follows:

Enrollment, (headcount) Fall 2007: 28,025

- Male Undergraduate: 11,807
- Female Undergraduate: 9,614
- Male Graduate and First Professionals: 3,679
- Female Graduate and First Professionals: 2,925

In a typical year, there is representation from each of the counties in Utah, every state in the United States, and at least 100 different countries.

C.4 Socioeconomics

Most of the students, many of the faculty, and a majority of the staff are residents of and in the State of Utah. A study completed in 2001, as part of the Olympic planning process, concluded that approximately two-thirds of those who commute to campus live within five miles of the campus. It is thus appropriate, for this purpose, to examine the socioeconomics of Salt Lake County. It is the most representative profile of individuals associated with the University of Utah.

The following excerpts from the *Utah Economic and Business Review* describe the socioeconomics of Utah, and specifically Salt Lake County**:**

- Salt Lake County is the economic, political, and cultural center of Utah and is expected to remain so for the foreseeable future. The county is currently home to nearly 40% of Utah residents and generates about half of all jobs in the state.

- Salt Lake County has a younger population, larger household sizes, and less ethnic and racial diversity than the nation.

- It has an older and more diverse population with smaller households than the rest of the state. If trends continue, the 60 and older population in Salt Lake County will surpass the school-age population by 2033 and exceed it by over 70,000 by 2050.

- Salt Lake County attracts more immigrants and more ethnically and culturally diverse populations than does the rest of Utah.

(Source: Utah Economic and Business Review, a publication of the Bureau of Economic and Business Research; David Eccles School of Business. http://www.business.utah.edu/bebr/bebrFiles/)

Research has demonstrated that both individual incomes in most job categories as well as per capita income in Utah are consistently lower than they are in neighboring states or compared to the national average. Arguably, larger families with more young children are among the factors driving this phenomenon.

C.5 Hazard History

FEMA has assembled a list of types of disasters that could affect entities and individuals across the states and territories associated with the United States. Across the United States that list includes: Avalanche, Coastal Erosion, Coastal Storm, Dam Failure, Drought, Earthquake, Expansive Soils, Extreme Heat, Flood, Hailstorm, Hurricane, Land Subsidence, Landslide, Severe Winter Storm, Tornado, Tsunami, Volcano, Wildfire, and Windstorm.

In this part of Utah, particularly at the geographical location of the main campus of the University of Utah, a number of the potential phenomena listed above have no history of ever having occurred, nor is there any likelihood that they will. Historically, the following types of disasters have manifested themselves to various extents, although never yet to where they would actually qualify as a disaster.

Table 3: Hazard event history

Hazard / Event Description	**Information source**
Earthquakes	State of Utah Mitigation Plan USGS FEMA University of Utah Department of Civil Engineering
Flooding; Inundation	University Risk Management State of Utah Mitigation Plan CUWCD SLCPU Campus History
Wildfire	State of Utah Mitigation Plan Campus History University Risk Management

C.5.1 Flooding

C.5.1.1 Primary Flooding Events

The campus of the University of Utah is located in the northeast corner of Salt Lake Valley, on a west-facing slope of the Wasatch Front mountain range. Its topography exhibits a downward slope of approximately 400 feet from the eastern edge of the developed campus to its west perimeter. There are currently no streams or open bodies of water (natural or man-made) on or uphill from the main campus.

Rain and snowstorms typically move in from the west and/or the south. This corner of the valley will, at times, receive greater amounts of precipitation than other parts of the Salt Lake Valley. It is quite normal for the upper parts of the campus to receive significantly higher amounts of precipitation, as contrasted against the University's western precincts.

Red Butte Creek, normally a low-volume stream, separates the main campus from Research Park. In the spring of 1983, it briefly overflowed its banks in the area of the greenhouses, located adjacent to the stream near the mouth of Red Butte Canyon. This event was the direct result of a heavy winter with its subsequent heavy snow melts. The impact was minimal, with no injuries or losses being reported. No other such incidents have occurred in recent memory.

On the north side of Red Butte Creek, in the late 1990's, the University constructed a number of two, three and four story student apartment buildings. Red Butte Gardens & Arboretum operates several greenhouses located north of the historical riverbed of Red Butte Creek at the eastern edge of the campus. In addition, the Gardens operate an amphitheater and other outdoors exhibits along both sides of the creek. Several privately owned facilities abut the stream along its southern bank on the Research Park side. Further west on the south side of the Red Butte Creek and east of Foothill Drive, the University of Utah Hospital operates several programs out of University owned buildings: the Orthopedic Hospital and the Professional Health Education Building. Located in privately owned buildings along the south side of Red Butte Creek are the University's Human Resources Department and several Health Sciences functions. Further west along the south side of the stream the University owns a number of apartment units (USA), erected in the 1950s and 1960s.

Like any university campus, this institution possesses a large number of parking lots, roadways, roofs, and other impervious surface areas. Historically, this characteristic contributed to the infrequent flooding of several neighborhood homes to the northwest of the campus, causing minor damage. The University resolved this problem by providing significant additional storm sewer capacities on the north side of the campus, improved diversions uphill from the homes, along with several detention/retention basins designed to handle at least a 100-yr storm. No incidents of flooding have been reported since those corrective measures were implemented in the 1990s.

There are no other reported incidents of flooding directly caused by weather conditions on the campus of the University of Utah within the last 50 years.

The probability of occurrence for such an event is therefore to be considered to be at or near zero.

C.5.1.2 Secondary Flooding Events

Located on the higher edge of the campus are several potable water reservoirs with a total capacity of 3 million gallons. These are owned operated by the University of

Utah. Salt Lake City's Department of Public Utilities owns and controls an 18" water line that parallels that eastern edge of the campus, which supplies most the University's water needs as well as that of its neighbors.

Questar owns an easement for a large volume natural gas distribution line through this area. Adjacent to the gas lines Chevron operates a couple of large diameter crude oil supply lines feeding the refineries north of Salt Lake City. Both of these lines operate under considerable pressure and special conditions, and are closely monitored by the two entities.

One set of risks at the University that could lead to damage to or loss of assets is associated with the aging underground infrastructure related to the water distribution system. The campus is a spaghetti bowl of many miles of domestic water lines, owned by either the University or Salt Lake City Public Utilities. Some of the domestic water lines date back to when this campus was mostly a military installation—prior to World War II, with some parts of the system allegedly pre-dating WWI.

Both systems have had numerous ruptures, with some damage to the flooding having been reported inside adjacent facilities. One of the most significant events happened in 1962, when a city-owned aqueduct east of the Park Bldg. ruptured (with help from a contractor's track-hoe) creating a 30 ft. geyser that in turn flooded most of the buildings around the northern perimeter of President's Circle.

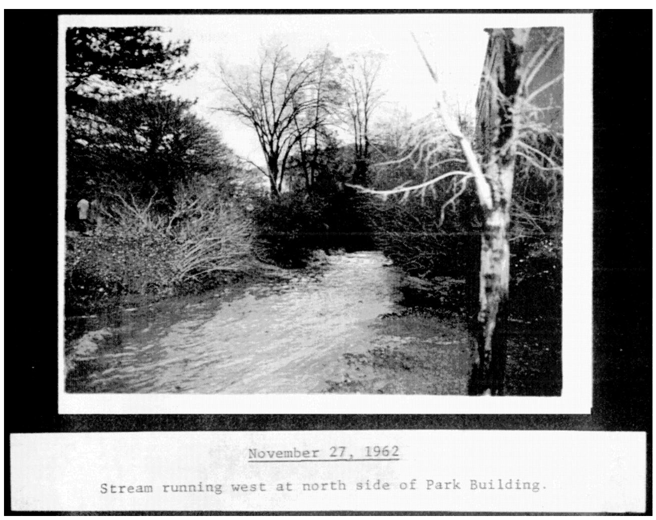


Figure 4: Aqueduct rupture floods sidewalk beside Park Building, 1962

One lesson learned from this event was to avoid storing critical records and operating a data center located in a below-grade level of an at-risk building.

Breaks in the University's water distribution system have also occurred, occasionally resulting in reports of damage to assets located in basements or bottom levels of structures located downhill from the ruptures. Most of the water damage recorded by the Office of Risk Management at the University is the result of water line failures inside of buildings.

Salt Lake City Public Utilities Department has shared with the University its emergency management and response plan pertaining to its water distribution assets above and on the campus. There is an active communication link between SLCPUD and the University of Utah in regard to these systems. Simultaneously, the University is formulating a planned replacement strategy for portions of this system.

There are many miles of direct-bury High Temperature Water distribution trunk and lateral lines on campus that are now 30-50 years old. The first significant HTW line rupture occurred in September 1979. Since then, there have been a handful of ruptures nearly every year. These failures are most commonly attributed to soil conditions, design or construction failures, and an inferior insulation system designed but not able to protect the steel lines from external corrosion. Quite recently, a ruptured high-temperature water line flooded the bottom level and the mechanical room of the Cowles Building. Design specifications at the University of Utah have recently been modified, making it less likely that this type of event will re-occur in the more recently installed and future portions of this system.

Equally at risk from a secondary flood is a medium-voltage underground electrical distribution system (12,470V or less) owned and maintained by the University of Utah. The combination of aging switchgear in electrical vaults that are frequently below grade, outdated lead-shielded electrical cable encased in crumbling concrete conduits, and proximity to "wet" distribution systems holds the potential of undesirable downtimes in providing electricity to a limited number of critical buildings. There have been occurrences during recent decades where sections of the electrical distribution system have failed as a result of unrestricted excessive water flows, both surface and underground. Impact on buildings and associated within them has been significant, on occasion—depending on the severity of the failure in this distribution system.

<u>University administrators are currently actively seeking capital development funds from the Utah State Legislature to address replacement or upgrade needs associated with each of these systems.</u> They will also explore other potential funding opportunities.

C.5.1.3 <u>Dam Failure and Inundation</u>

Directly east of the University of Utah, Red Butte Creek flows through a small reservoir. The Red Butte reservoir itself is located approximately .5 miles away from and

400 ft. above the main campus. The dam is basically an earthen dam constructed in or about 1930.

This 10-acre reservoir was built at a cost of $350,000. Its 385 acre-feet of storage capacity was designated as the primary water supply for Fort Douglas and all other federal properties on the east bench of the valley. (For additional historical information about the dam, refer to http://redbuttecanyon.net/protectedwatershed.html)

In 1985, Fort Douglas abandoned use of the reservoir as a water resource due to excessive silting within the reservoir and sand in the downstream water supply. An engineering study had demonstrated that it was no longer cost effective for the Fort to rely on this resource for drinking water, considering the cost of required upgrades to their system. They continued to use it briefly as a source for irrigation water, but eventually also abandoned that function.

By 2000, the associated infrastructure had fallen into disrepair. By 2003, Red Butte Dam was dams listed on the state's hazardous list, among others in the state. The National Defense Authorization Act of 2000 had already authorized spending, not to exceed $6 million, to improve the dam and the reservoir so that they would meet applicable state standards (See: http://des.utah.gov/homelandsecurity/damsafety.html). The project invested heavily in the restoration of the dam and associated spillways, monitoring technologies, conduits and controls. In 2004 the Central Utah Water Conservation District (CUWCD) became the designated owner of the reservoir and the dam, releasing the Forest Service from that responsibility. The needed improvements are now in place, according to Mr. Jackson Crofts of the CUWCD. The University's representatives have access to CUWCD's emergency management and response plan, and are in constant contact with that agency's representatives.

The water level in the reservoir behind the dam is intentionally maintained at partial capacity. The storage in the reservoir is used exclusively for study by scientists and biologists, many of whom are associated with the University. The reservoir provides a sanctuary to the June sucker, an endangered species of domestic fish. The operation and management of the dam and the reservoir is dedicated to the genetic preservation of this small fish. (See: http://www.cuwcd.com/redbutte2005/assets/redbutte_scope_work.pdf)

Since its original construction, this dam has not demonstrated any threat of direct failure, and has not contributed to any downstream fatalities or loss of property.

As noted above, this dam was recently reconstructed, thereby alleviating any lingering concerns about potential failures.

C.5.2 Wildfire

The types of vegetation native to the foothills east of the campus have suffered several wildfires that posed a potential threat to facilities on campus. However, according to the office of Risk Management at the University of Utah has no record of such an event actually directly impacting the University. There was what some might consider a close call 20 years ago, as a wildfire erupted above Red Butte Gardens. However, this wildfire never progressed to where it actually impacted the Gardens, any of its facilities, nor any other assets of the University of Utah.

C.5.3 Severe Winter Storms, Hailstorms and Winds

The location of the University of Utah brings occasionally heavy snowstorms. Over the years, according to the University's Office of Risk Management's records, there has been some damage reported through roof leaks, power outages, and reports of other secondary effects due to snow loading, with no associated injuries or loss of life.

Mostly, since much of the campus is on a natural slope due to its location on the foothills of the Wasatch Range, the few injuries that are reported after a heavy winter storm are typically slips and falls. Depending on the severity of the winter, there is an average of one to two of such claims per season.

A pressurized air structure covering an indoor football practice field, known as the "Bubble", collapsed as a result of such a heavy snowstorm, in combination with very strong wind reported at the time as reaching velocities of 100 mph. This resulted in an insurance claim of approximately $350,000. Fortunately, the timing of the event was such that there was no one in the structure, avoiding any loss of life or injury. This air structure was replaced by a permanent building in 2004.

Occasionally, the campus is subjected to strong winds, typically identified as strong "canyon winds." Aside from the aforementioned incident with the Bubble, and minor roof damage, trees represented the main losses associated with those winds. Current building standards applied to design and construction of new buildings exceed typical maximum wind velocities, with 100 mph the standard that is typically applied. This has already greatly reduced the amount of potential risk associated with this type of event.

Hailstorms have occurred on campus, with anecdotal reports of minor damage to personal vehicles. Otherwise, there were no other reports of losses associated with this type of event.

Lightning strikes are a common phenomenon throughout Utah, as well as in the proximity of the University of Utah campus. Fortunately, there have been no reported casualties associated with lightning strikes on the campus. This is in contrast to the State of Utah overall, since lightning is one of the more significant causes of death or injury caused by natural events. In the last 10 years, assets owned by the University were damaged four times by lightning strikes, twice on campus and twice at remote locations. (See related discussions in Section D.2.5.)

C.5.4 Severe Seismic Events

The main campus of the University of Utah is known to be located both over and close to identified and yet unknown fault lines. The potential for losses in terms of human life, assets, as well as economic losses is well recognized. There is no record of any such losses having occurred yet in the University's history. To date, no claims have been triggered by seismic events.

C.5.5 Landslides

Utah has experienced several significant landslides in fairly recent history. Examples are the Thistle area slide, as well as the Santaquin area slides. Bountiful, just to the north of Salt Lake City, has had to endure mudslides in recent years. Much of the blame for such events has been placed on ill-conceived land use and urban design. The campus of the University of Utah has never suffered from a landslide. The Office of Risk Management indicates that there have been no reports of any losses of any type associated with this type of event

C.5.6 Pandemics

Like much of the community surrounding the University, different forms of influenza have impacted individuals and activities on campus. However, there has not yet been a case where the campus community has had to close down or be placed in either quarantine or isolation as a result of such an event.

C.5.7 Other human caused events

The University of Utah has had several instances directly the result of human-caused events. In the 1960s, a vacant barracks-type building was burned to the ground, resulting from a presumed arsonist's activities. There was no loss of life associated with this event, and the building was scheduled to be demolished shortly after in any case. More recently, for reasons unknown, a student set a series of small fire. None of those fires resulted in significant loss of property, or in loss of life. Other events that held the potential of risk to property or people were unintentional and/or accidentally caused.

C.5.8 Shootings

The University of Utah has not had any reports of shootings or similar types of violence on the campus, nor of any injuries or damage of such activities.

C.5.9 Tornado

The Salt Lake Valley has suffered through an occasional, but very rare, tornado. However, the University suffered no loss or impact of any type as a result of these events.

D. Hazard Assessment

§201.6(c)(2)(i)

D.1 Hazard Prioritization

The following table is based on input from individuals at the University of Utah familiar with the nature of the campus and its history, including representatives from University Police, University Hospital, Environmental Health & Safety, Facilities Management, Risk Management, and Space Planning & Management. The information identifies potential hazards and their respective ranking scores based on the following criteria:

i) frequency – how often the hazard occurs
ii) duration – how long the hazard or the impact of the hazard may last,
iii) severity – the extent of the hazard impact,
iv) intensity – how strong the hazard is felt on campus.

Each ranking factor is on a scale of 0-5 (0 being the lowest, 5 being the highest).

Table 4: Hazard ranking

Hazard	**Ranking Factors**				**Ranking**
	Frequency	Duration	Severity	Intensity	
Catastrophic Earthquake	1	4	4	4	13
Pandemic Flu	1	4	3	2	10
Landslide	2	1	1	2	6
Flood (including dam failure)	3	1	2	2	8
Severe Weather	4	1	2	2	9
Wildfire	3	1	2	1	7
Terrorism	2	1	1	1	5

D.2 Land Use and Development Trends

§201.6(c)(2)(ii)(C)

Campus land use and development trends fall under the responsibility of the Campus Master Plan. As mitigation planning will be considered an integral component of the overall development trends and land use of campus grounds, we refere to the current plan at http://campusmasterplan.utah.edu.

D.3 Hazard Profiles

§201.6(c)(2)(i)

This section profiles the hazards that are outlined in the preceding table. The purpose of a hazard profile is to quantify, as much as possible, the potential risk associated with a specific hazard and to set the stage for potential mitigation actions. To do this, a brief sketch of the hazard is provided along with a summary of risk factors, background and local conditions, frequency and probability of occurrence, severity, historic losses and impacts, and a list of designated hazard areas.

Some hazards may have more detail than others because of the availability of data related to the known characteristics of the hazard. Detailed scientific explanations of each hazard are not necessarily examined in a mitigation-planning document, but some details will be provided to document processes of hazard analysis, particularly for earthquake risk.

D.3.1 Catastrophic Earthquake

D.3.1.1 Summary of Risk Factors

Table 5: Summary of risk factors: earthquake

Period of occurrence:	~ 1000 – 1200 year recurrence interval
Probability of event(s):	Low
Warning time:	None
Major contributor(s):	Geologic stress
Risk of injury?	High
Potential for facilities shutdown?	High
Percent of affected properties that may be destroyed or suffer major damage:	Damage state probabilities from HAZUS aggregate losses report (1000 year event): Structural – 10% none, 20% damage, 30% moderate, 20% damage, 20% complete. Non-structural drift – 12% none, 19% slight, 35% moderate, 12% extensive, 20% complete. Non-structural acceleration – 25% none, 30% slight, 20% moderate, 10% extensive, 15% complete.

§201.6(c)(2)(i)(A)

D.3.1.1(a) Notable buildings from a casualties perspective

§201.6(c)(2)(i)(B)

There were over 250 buildings studied in the HAZUS Advanced Engineering Building Module (AEBM) analysis. It is important to understand that the HAZUS Earthquake Model in AEBM is the best guesstimate available without performing expensive site-specific engineering studies on each building. As such, any potential losses (either casualty or economic) should be used as planning guidelines only, and not for a strict benefit-cost analysis or authoratitive prioritization. The buildings listed below are only a subset and a representation of all buildings in the study.

As life safety is our primary goal, we itemize below a number of buildings with significant casualties. In doing so we caution over-emphasis on the number of potential casualties, as this is directly correlated to the number of occupants. While we maximized occupants in order to portray a "worst case" scenario, our large assembly spaces (Huntsman, Kingsbury, Pioneer Theatre) are not as frequently used as our smaller spaces, thus the order of the buildings below must be seen from that perspective.

Table 6: Buildings of concern (casualties due to earthquake)

ID	Name	Occupant estimate	Potential casualties (all levels)
90	Jon M. Huntsman Center	15,000	995 (81 potential deaths)
4	Kingsbury Hall	1,913	241 (16 potential deaths)
521	School of Medicine	3,282	174 (14 potential deaths)
93	HPER South Natatorium	1,000	96 (9 potential deaths)
53	A. Ray Olpin Union	737	73 (7 potential deaths)
91	HPER East	1,500	97 (6 potential deaths)
54	Orson Spencer Hall	1,391	88 (6 potential deaths)
85	Henry Eyring Building	773	57 (5 potential deaths)
5	George Thomas Building	500	50 (5 potential deaths)
66	Pioneer Memorial Theatre	932	64 (4 potential deaths)

D.3.1.1(b) Notable buildings from an economic loss perspective

Economic loss within a building is another perspective from which to view potential impacts. When analyzed in AEBM, the following buildings had the greatest potential for economic loss, in part because of buildings function in science, medicine or engineering. However, other buildings had high economic loss because the construction materials in the building contributed to overall frailty.

Table 7: Buildings of concern (economic loss in $1000s due to earthquake)

ID	Name	Building value	Potential economic loss
64	Merrill Engineering	106,156	82,947
521	School of Medicine	98,957	51,850
525	University Hospital	174,610	36,522
85	Henry Eyring Building	61,902	35,942
53	A. Ray Olpin Union Building	46,488	31,183
90	Jon M. Hunstman Center	51,372	27,547
5	George Thomas Building	19,656	27,449
84	Biology Building	32,976	20,445
54	Orson Spencer Hall	27,115	17,755
25	Social & Behavioral Sciences Tower	24,323	16,437

D.3.1.1(c) Notable buildings from a complete damage state perspective

The HAZUS Earthquake methodology uses five damage states (none, slight, moderate, extensive, complete) to describe potential impacts to a building. These damage states are applied to two general categories (structural and non-structural building elements). The buildings below ranked high on the complete damage state potential due to a combination of their contruction materials, an inference of building codes and standards based on the year of construction, and their overall seismic design level.

Table 8: Buildings of concern (complete damage state potential)

ID	Name	Complete damage state
5	George Thomas Building	59.75%
73	S.J. Quinney College of Law	59.75%
6	William Stewart Building	59.75%
53	A. Ray Olpin Union Building	58.50%

38	Art Building	58.50%
37	Architecture Building	58.50%
25	Social & Behavioral Sciences Tower	58.35%
93	HPER South - Natatorium	56.67%
66	Pioneer Memorial Theater	56.49%
4	Kingsbury Hall	59.75%

D.3.1.1(d) Notable buildings from a mission critical perspective

A third perspective from which to understand high-level impacts is that of mission critical buildings. Mission critical levels and functions are defined in Section A.7.1 Defining Criteria. The following table ranks mission critical buildings that also score high on fatalities and economic loss.

Table 9: Earthquake loss ($1000s) in selected mission critical buildings

ID	Name	Mission crit. *	Deaths	Economic loss
521	School of Medicine **	3	14	62,137
525	University Hospital **	3	4	36,559
1	John R. Park Building	3	2	14,728
86	Marriot Library **	3	1	124,144
853	Health Profession Education Building	2	1	5,906
4	J.T. Kingsbury Hall	1	16	7,976
38	Art Building	1	3	8,607
26	Social Work Building	1	3	6,336
8	Alfred C. Emery Building	1	3	4,280
521	Social & Behavioral Sciences Tower **	1	14	16,593

* Mission critical legend: 3 = uninteruptible, 2 = urgent restoration, 3 = restoration as possible.
** These buildings are presently under review with Facilities Management. In the case of the Marriott Library, the a structural retrofit has been completed to significantly higher seismic codes.

D.3.1.1(e) Summary of earthquake building analysis

A number of high-level observations may be made: academic and hospital facilities with poor structures are already being considered for mitigation via the Campus Master Plan. The remaining buildings of concern address high occupancy spaces in athletics, arts, science and engineering. Work has already been completed

(Marriott Library retrofit) or is in the early planning stages for a number of high risk buildings.

D.3.1.1(f) Additional building analysis results

§201.6(c)(2)(i)(B)

The entire array of HAZUS earthquake analysis results using the Advanced Engineering Building Module are captured in the Aggregated and Individual Building Reports generated by the DIGIT Lab. Because of the size and technical nature of this comprehensive document, and due to considerations of variations in model parameters and outputs, these reports are included as an *external* appendix and are not available in the main body of this mitigation plan.

D.3.1.2 Hazard Profile Data

When a sudden release of energy stored in deep bedrock occurs, the trembling and ground shaking that occur is called an earthquake. These energy releases are found along fault lines – cracks deep in the bedrock that give way if tension or compression forces acting on them are too great. Some earthquakes are undetectable by the human senses, while others can shake the ground violently for 10 to 30 seconds, with repetitive aftershocks that may continue for hours and even days. Most injury and deaths from earthquakes are a result of buildings or their components breaking apart under the stress of ground motion.

D.3.1.3 Background and Local Conditions

The Wasatch Fault is a complex of fault segments known as one of the most active in the world and is part of the Intermountain Seismic Belt (ISB). The fault is considered a normal fault because the slip is mostly vertical (the valley slips down and the mountain moves up). The University of Utah straddles the Salt Lake segment of the Wasatch fault. Quaternary maps from the United States Geological Survey (USGS) show that a portion of the Salt Lake segment bisects campus roughly from the southwest to the northeast.

D.3.1.4 Historic Frequency and Probability of Occurrence

Determining the frequency, or *recurrence interval*, of potential earthquakes is a difficult science. Studies show that at least 19 significant earthquakes have occurred on the Wasatch fault during the past 6000 years. Best estimates put the recurrence interval for the Salt Lake segment around 1200 years, with the last one occurring about 1200 years ago (*The Wasatch Fault, Public Information Series #40, Utah Geological Society*).

While this estimate is not a definite predictor, it is an indicator that the area has earthquake potential.

D.3.1.5 Severity

Earthquakes measure magnitude for a number of variables, including: duration; energy waves on the surface or below the ground; the length of the fault; or the rigidity of the earth. Despite the differences in magnitude types, it is understood that larger magnitude earthquakes produce more damaging results.

The State of Utah Mitigation Plan (2007) discusses the largest probable earthquake as a magnitude 7.0 – 7.5 that would most likely occur on the Wasatch Fault. Based on this prediction, the University used an advanced analytical modeling software application – HAZUS-MH (Hazards U.S. – Multi-hazards) in order to estimate loss of life and property. The DRU team elected to use this application and its accompanying Advanced Engineering Building Module (AEBM) to model loss probabilities from an M7.0 earthquake.

D.3.1.6 Historic Losses and Impacts

The last significant seismic event along the Salt Lake segment of the Wasatch fault occurred long before recorded civilization appeared in the area. There is no known record, and therefore no reliable historic data, that quantifies losses and impacts. For this reason we need to depend on the estimates made by the HAZUS-MH models, which have proven themselves reliable in post-earthquake analysis for modern-day events in other locations.

D.3.1.7 Designated Hazard Areas

Because of the large geographic area impacted by an earthquake, the entire University campus is considered to be a hazard area for earthquake risk. Within our community, however, some structures are more at-risk than others. Chief among them are un-reinforced masonry buildings, and tall buildings built to sub-standard seismic codes.

We have identified and mapped over 250 facilities from our AEBM analysis with their potential damage states and estimated casualty numbers. Propelled by our sensitivity to security concerns, these maps remain confidential but are readily available to campus administrators responsible for emergency planning and management and long-range capital planning activities, to aid in their decision-making processes.

D.3.2 Pandemic Flu

§201.6(c)(2)(i)(A)

D.3.2.1 Summary of Risk Factors

Period of occurrence:	30 years
Probability of event(s):	High (at 30 year window)
Warning time:	1 month
Major contributor(s):	Migratory birds, hygiene, travel
Risk of illness?	High
Potential for facilities shutdown?	High
Percent of affected properties that may be destroyed or suffer major damage:	Low or none

D.3.2.2 Hazard Profile Data

A pandemic is a global disease outbreak. A flu pandemic occurs when a new influenza virus emerges for which people have little or no immunity, and for which there is no vaccine. The disease spreads easily person-to-person, causes serious illness, and can sweep across the country and around the world in very short time.

A pandemic may come and go in waves, each of which can last for six to eight weeks. An especially severe influenza pandemic could lead to high levels of illness, death, social disruption, and economic loss. Everyday life would be disrupted because so many people in so many places become seriously ill at the same time. Impacts can range from school and business closings to the interruption of basic services such as public transportation and food delivery.

A substantial percentage of the world's population will require some form of medical care. Health care facilities can be overwhelmed, creating a shortage of hospital staff, beds, ventilators and other supplies. Surge capacity at non-traditional sites such as schools may need to be created to cope with demand.

The need for vaccine is likely to outstrip supply and the supply of antiviral drugs is also likely to be inadequate early in a pandemic. Difficult decisions will need to be made regarding who gets antiviral drugs and vaccines.

D.3.2.3 Background and Local Conditions

The Influenza Pandemic occurred in three waves in the United States throughout 1918 and 1919. The first cases in Utah undoubtedly appeared in the military camp at Fort Douglas. Public health officials reacted by passing laws requiring citizens to wear masks. Spitting, a common practice, was condemned and those who spit in public were fined.

Quarantines were imposed. In Ogden City no one was allowed in or out of the city without a note from a doctor. Elsewhere, church meetings, funerals, private parties and all public gatherings were cancelled or limited. For instance, when Joseph F. Smith, president of the Church of Latter Day Saints of Jesus Christ, died on November 19th, the service was limited to only a few family members. At other times, this type of event would have attracted thousands of mourners.

The State of Utah, Health and Human Services (HHS) and other federal agencies held a pandemic planning summit on March 24, 2006, with public health and emergency management and response leaders from within the state in attendance. On that date, HHS Secretary Mike Leavitt and Utah's Governor Jon M. Huntsman, Jr. signed a Planning Resolution detailing HHS' and Utah's shared and independent responsibilities for pandemic planning.

Utah's Pandemic Preparedness Plan was first released in 2005. It is detailed at http://health.utah.gov/epi/diseases/flu/ClinicianPublicHealth/pandemic/pandemic_influenza_plan.pdf

The University of Utah has complex exposures to balance in the day-to-day business of treating patients, conducting research, and educating students. Residence life, fraternities and sororities, students on internship programs, and laboratory environments represent a small cross-section of these unique risks. The complexity of the problem is increased by the large number of students that commute to the campus on a daily basis, and by the large number of visitors (10,000 to 20,000 per day) that come to the campus on a typical business day.

D.3.2.4 Historic Frequency and Probability of Occurrence

It is impossible to predict with any degree of accuracy when the next influenza pandemic will occur or how severe it will be. Wherever and whenever a pandemic starts, everyone around the world is at risk. Countries such as the United States might delay arrival of the virus through measures such as border closures and travel restrictions, but will not be able to stop or prevent its eventual transmission.

Health professionals are concerned that the continued spread of a highly pathogenic avian H5N1 virus across eastern Asia and other countries represents a significant threat to human health. The H5N1 virus has raised concerns about a potential human pandemic because:

- It is especially virulent (the relative ability of a pathogen to cause disease)
- It is being spread by migratory birds
- It can be transmitted from birds to mammals and in some limited circumstances to humans, and
- Like other influenza viruses, it continues to evolve.

Since 2003, a growing number of human H5N1 cases have been reported in Asia, Europe, and Africa. More than half of the people infected with the H5N1 virus have died. It is believed that most of these cases were caused by exposure to infected poultry. There has been no sustained human-to-human transmission of the disease, but the continued concern is that H5N1 will evolve into a virus capable of human-to-human transmission.

Death rates are determined by four factors: the number of people who become infected, the virulence of the virus, the underlying characteristics and vulnerability of affected populations and the availability and effectiveness of preventive measures.

D.3.2.5 Severity

D.3.2.5(a) Pandemic Death Toll Since 1900 (Center for Disease Control)

1918-1919 – U.S (675,000+), Worldwide (50,000,000)
1957-1958 – U.S (70,000+), Worldwide (1,000,000 - 2,000,000)
1968-1969 – U.S (34,000+), Worldwide (700,000+)

D.3.2.6 Historic Losses and Impacts

History suggests that influenza pandemics have probably happened during at least the last four centuries. Since 1900, three pandemics and several "pandemic threats" have occurred.

D.3.2.6(a) 1918: Spanish Flu

The Spanish Influenza pandemic is the catastrophe against which all modern pandemics are measured. It is estimated that approximately 20 to 40 percent of the worldwide population became ill and that over 50 million people died. Between September 1918 and April 1919, approximately 675,000 deaths from the flu occurred in the U.S. alone. Many people died from this very quickly. Some people who felt well in the morning became sick by noon, and were dead by nightfall. Those who did not succumb to the disease within the first few days often died of complications from the flu (such as pneumonia) caused by bacteria.

One of the most unusual aspects of the Spanish flu was its ability to kill young adults. The reasons for this remain uncertain. With the Spanish flu, mortality rates were high among healthy adults as well as the usual high-risk groups. The attack rate and mortality was highest among adults 20 to 50 years old. The severity of that virus has not been seen again.

D.3.2.6(b) 1957: Asian Flu

In February 1957, the Asian influenza pandemic was first identified in the Far East. Immunity to this strain was rare in people less than 65 years of age, and a pandemic was predicted. In preparation, vaccine production began in late May 1957, and health officials increased surveillance for flu outbreaks.

Unlike the virus that caused the 1918 pandemic, the 1957 pandemic virus was quickly identified, due to advances in scientific technology. Vaccine was available in limited supply by August 1957. The virus came to the U.S. quietly, with a series of small outbreaks over the summer of 1957. When U.S. children went back to school in the fall, they spread the disease in classrooms and brought it home to their families. Infection rates were highest among school children, young adults, and pregnant women in October 1957. Most influenza-and pneumonia-related deaths occurred between September 1957 and March 1958. The elderly had the highest rates of death.

By December 1957, the worst seemed to be over. However, during January and February 1958, there was another wave of illness among the elderly. This is an example of the potential "second wave" of infections that can develop during a pandemic. The disease infects one group of people first, infections appear to decrease and then infections increase in a different part of the population. Although the Asian flu pandemic was not as devastating as the Spanish flu, about 69,800 people in the U.S. died.

D.3.2.6(c) 1968: Hong Kong Flu

In early 1968, the Hong Kong influenza pandemic was first detected in Hong Kong. The first cases in the U.S. were detected as early as September of that year, but illness did not become widespread in the U.S. until December. Deaths from this virus peaked in December 1968 and January 1969. Those over the age of 65 were most likely to die. The same virus returned in 1970 and 1972. The number of deaths between September 1968 and March 1969 for this pandemic was 33,800, making it the mildest pandemic in the 20th century.

There could be several reasons why fewer people in the U.S. died due to this virus. First, the Hong Kong flu virus was similar in some ways to the Asian flu virus that circulated between 1957 and 1968. Earlier infections by the Asian flu virus might have provided some immunity against the Hong Kong flu virus that may have helped to reduce the severity of illness during the Hong Kong pandemic. Second, instead of peaking in September or October, like pandemic influenza had in the previous two pandemics, this pandemic did not gain momentum until near the school holidays in December. Since children were at home and did not infect one another at school, the rate of influenza illness among schoolchildren and their families declined. Third, improved medical care and antibiotics that are more effective for secondary bacterial infections were available for those who became ill.

D.3.2.6(d) 1976: Swine Flu Threat

When a novel virus was first identified at Fort Dix, it was labeled the "killer flu." Experts were extremely concerned because the virus might have been related to the Spanish flu virus of 1918. The concern that a major pandemic could sweep across the world led to a mass vaccination campaign in the United States. In fact, the virus--later named "swine flu"--never moved outside the Fort Dix area. Research on the virus later showed that if it had spread, it would probably have been much less deadly than the Spanish flu.

D.3.2.6(e) 1977: Russian Flu Threat

In May 1977, influenza A/H1N1 viruses isolated in northern China, spread rapidly, and caused epidemic disease in children and young adults (< 23 years) worldwide. The 1977 virus was similar to other A/H1N1 viruses that had circulated prior to 1957. (In 1957, the new A/H2N2 viruses replaced the A/H1N1 virus). Because of the timing of the appearance of these viruses, persons born before 1957 were likely to have been exposed to A/H1N1 viruses and to have developed immunity against A/H1N1 viruses. Therefore, when the A/H1N1 reappeared in 1977, many people over the age of 23 had some protection against the virus and it was primarily younger people who became ill from A/H1N1 infections. By January 1978, the virus had spread around the world, including the United States. Because illness occurred primarily in children, this event was not considered a true pandemic. Vaccine containing this virus was not produced in time for the 1977-78 season, but the virus was incorporated into the 1978-79 version of the vaccine.

D.3.2.6(f) 1997: Avian Flu Threat

The most recent pandemic "threats" occurred in 1997 and 1999. In 1997, at least a few hundred people became infected with the avian A/H5N1 flu virus in Hong Kong and 18 people were hospitalized. Six of the hospitalized persons died. This virus was different because it moved directly from chickens to people, rather than having been altered by infecting pigs as an intermediate host. In addition, many of the most severe illnesses occurred in young adults similar to illnesses caused by the 1918 Spanish flu virus. To prevent the spread of this virus, all chickens (approximately 1.5 million) in Hong Kong were slaughtered. The avian flu did not easily spread from one person to another, and after the poultry slaughter, no new human infections were found.

In 1999, another novel avian flu virus - A/H9N2 - was found that caused illnesses in two children in Hong Kong. Although both of these viruses have not gone on to start pandemics, their continued presence in birds, their ability to infect humans, and the ability of influenza viruses to change and become more transmissible among people is an ongoing concern.

D.3.2.7 Designated Hazard Areas

There is no designated hazard area for this type of hazard at the University of Utah.

D.3.3 Landslide

D.3.3.1 Summary of Risk Factors

§201.6(c)(2)(i)(A)

Table 10: Summary of risk factors: landslide

Period of occurrence:	Frequent for small events
Probability of event(s):	Low to moderate susceptibility near campus
Warning time:	Little
Major contributor(s):	Gravity, precipitation, earthquakes
Risk of injury?	Low to medium
Potential for facilities shutdown?	Partial
Percent of affected properties that may be destroyed or suffer major damage:	Less than 5%, but in area of hospitals

D.3.3.2 Hazard Profile Data

Landslides are mass movement events that include rock fall, slope failure, and debris flow. While gravity is the primary factor in landslides they are usually triggered by an increase in precipitation or erosion. As a slope is loaded with precipitation, the added weight can exceed the natural strength of the rocks and soils and cause a mass movement. Curiously, we often favor building expensive homes near to rivers whose banks may erode, or at the precipice of cliffs or on sides of mountains whose slopes may fail. When a mass movement of rocks, trees, and enormous amounts of soil occurs, there is little to prevent homes and properties from being destroyed.

D.3.3.3 Background and Local Conditions

The Wasatch Range provides an ideal environment for frequent landslides. The Utah Geological Society reports that three common types of landslides in Utah are: 1) debris flow, 2) slides, and 3) rock fall (http://geology.utah.gov/online_html/pi/pi-58/pi58pg1.htm).

The University of Utah is nestled against lower, older foothills of the Wasatch front. Because of their age, these foothills have been previously eroded by wind and rain and are now – from a general, coarse perspective – mostly “smooth” and do not exhibit a tendency to slide. In general, slopes on the foothills behind the Health Sciences (or East), campus are not as steep, erosion is not as evident, and the accumulation of precipitation is not as severe as other areas along the same range beyond the borders of campus. There are some small areas along the Shoreline trail, east of the campus, where portions of the hillside are undercut both by natural and human causes. This condition has helped foster the University's determined need for the Heritage Preserve Plan.

The hospitals and the many research institutes and laboratories located in the northeast quadrant of the University of Utah have been built on or into the foothills. While structural engineers are confident with the design and construction of these facilities, it is understood that if the base of slope is undercut in any fashion, the natural strength of the slope is weakened and therefore more susceptible to landslide. Further construction in this area should pay particular attention to slope stability.

D.3.3.4 Historic Frequency and Probability of Occurrence

Landslides may occur as primary events, or secondary events following an earthquake. The largest landslide to date (both for Utah and the U.S.) was the Thistle Landslide of April 1983 in central Utah. A thousand feet in width, a mile long and almost 200 feet thick, this gigantic slump buried the town of Thistle and dammed the Spanish Fork River, causing the formation of Thistle Lake.

A major event like Thistle is not a high frequency event, but Utah does see frequent smaller landslides each year. There have been 15 damaging landslides documented in the five-year period between 2001 and 2006. Northern Utah experienced five damaging landslides in 2006, including one in the City Creek canyon, only 3 miles campus west of campus but in an area with much steeper slopes and more housing.

The latest Landslide Susceptibility Map (2007) from the Utah Geological Society demonstrates that the foothills adjacent to campus have low to moderate susceptibility, based on slope angles from 5 to 7 degrees (low) and from 7 to 18 degrees (moderate). The map is available at http://geology.utah.gov/online/m/m-228.pdf.

D.3.3.5 Severity

The Thistle landslide was severe, causing the destruction of an entire community and the mandatory relocation of its population. Northern Utah landslides have been less destructive overall, but severe for the residents affected. In general, steeper slopes provide for more severe consequences for rockfall, and wet unstable soils provide for more severe consequences for debris flow. With moderate slopes and dry soils in the foothills near campus, we expect our severity to be low for a non-earthquake induced landslide. Further studies are justified to determine severity of a local landslide following an earthquake.

D.3.3.6 Historic Losses and Impacts

The Thistle event was the costliest single landslide in U.S. history. Some estimates have been placed at over $200 million. Social and economic impact was staggering for both the town and the state. This unique event obviously throws the average. A more conservative estimate of losses and impacts can be seen in the City Creek Canyon event in 2006: four homes were directly threatened, and protection efforts for one house exceeded $300,000.00. There are other locations along the Wasatch Front that are currently being closely watched by experts, as some ground shifting has already been experienced in those areas.
(See http://geology.utah.gov/utahgeo/hazards/landslide/2006ldslides_svnts.htm).

D.3.3.7 Designated Hazard Areas

There are no formal areas within the campus boundaries designated as landslide hazard areas. However, prudence indicates that attention should be paid to construction in the section of the campus abutting the foothills. Currently there is a strip of low sloping land approximately 500 feet wide behind and above the Health Sciences campus before the foothills present a much steeper slope. This area could be considered a buffer zone to mitigate the effects of a mass earth movement towards University property. Such is the premise of the Heritage Preserve.

D.3.4 Flood

D.3.4.1 100-year flood

D.3.4.1(a) Summary of Risk Factors

§201.6(c)(2)(i)(A)

Table 11: Summary of risk factors: 100-year flood

Period of occurrence:	None
Probability of event(s):	None
Warning time:	Not applicable
Major contributor(s):	Not applicable
Risk of injury?	None
Potential for facilities shutdown?	None
Percent of affected properties that may be destroyed or suffer major damage:	0%

D.3.4.1(b) Hazard Profile Data

The USGS indicates: "The term '100-year storm' is used to define a rainfall event that statistically has a 1-percent chance of occurring. In other words, over the course of 1 million years, these events would be expected to occur 10,000 times. But, just because it rained 10 inches in one day last year doesn't mean it can't rain 10 inches in one day again this year."

Table 12: Flood recurrence intervals

Recurrence intervals and probabilities of occurrences

Recurrence interval, in years	Probability of occurrence in any given year	Percent chance of occurrence in any given year
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Source: http://ga.water.usgs.gov/edu/100yearflood.html

Encountering a "100-year storm" on one day does nothing to change chances of seeing the same amount of precipitation the very next day. In fact, some experts are of the opinion that these severe storms are becoming more frequent. Arguably, the impression is that the phenomenon of global warming is at least partially for this increased frequency.

D.3.4.1(c) Background and Local Conditions

The State of Utah Pre-Disaster Mitigation Plan of 2004 places the statewide probability of substantial floods occurring in Utah at 12%, since Utah had recorded only 14 such events in 120 years of history. The situation at the University of Utah is such that any damage from nature-related floods is even less likely.

Most frequently triggered by a combination of heavy winters and subsequent snowmelt, compounded by heavy spring precipitation, some floods have impacted businesses and residences throughout the state during the last century.

One of the most significant and devastating events wiped out the small town of Thistle, a community that was nestled in Spanish Fork Canyon, south-west of Provo. An enormous landslide blocked a normally quiet stream in Spanish Fork Canyon, eventually inundating dozens of homes upstream from the blockage. There were no casualties resulting from this event. The loss of property was total and devastating for this small community, estimated at over $200 million. Thistle never recovered.

In 2005, the Santa Clara River rampaged through southwestern Utah, downstream from Gunlock Reservoir. The event was allegedly the result of a lack of maintenance of the streambed, with a combination of an unusually substantive amount of snowmelt and thunderstorms. The waters damaged several of homes, totally destroying at least seven. Also damaged were farmland, several golf courses as well as utility distribution systems and essential paved infrastructure. The governor of the State of Utah declared this zone a disaster area, enabling the involvement of FEMA.

There have been reports of casualties as a result of flooding in Utah. In 1984, a person was killed near Clearcreek, a small Utah mining town. There was also a fatality indirectly caused by the Santa Clara flood, described above. However, neither of those fatalities could be attributed to a “flash flood” situation, and were apparently the result of an unfortunate personal choice.

In more mature urban areas such as Salt Lake City, storm sewers have been in place for many years. These were originally designed to handle the infrequent yet occasionally heavy rainstorms, and also runoff generated by melting snow within the community and in the watershed located in the foothills above the city. As Salt Lake became more urbanized in the early twentieth century, creeks that flowed across the surface of the valley were forced into underground culverts and conduits. While these methods of conveyance aged, and quite possibly afterwards forgotten as critical infrastructure, the risk to surrounding structures increased. It is interesting to note that some of these streams are now being brought back to the surface.

In 1983, Salt Lake City and other communities along the Wasatch Front were impacted by notable flooding events. Salt Lake City was forced to turn State Street into a temporary river, safely guiding excess runoff to additional conduits. Since then, Salt Lake City has invested heavily in updating the design and the condition of its storm sewer system. This has an indirect impact on the University of Utah, since all of its storm sewer collection systems feed into Salt Lake City's system.

D.3.4.1(d) Historic Frequency and Probability of Occurrence

There are no reported incidents of flooding directly caused by severe weather conditions on the campus of the University of Utah. The probability of occurrence for such an event is therefore to be considered to be at or near zero.

In the spring of 1983, Red Butte Creek briefly overflowed its banks in the area of the greenhouses, resulting from a heavy and sudden spring run-off. However, there was no reportable damage as a result of this event, the only recorded occurrence of such an event in this area during the last fifty years. Recent modifications and improvements in the Red Butte area, both at the dam and at the Red Butte Gardens, are expected to preclude a recurrence.

D.3.4.1(e) Severity

Not applicable

D.3.4.1(f) Historic Losses and Impacts

There have been no losses associated with flooding caused by severe weather conditions at the University of Utah.

D.3.4.1(g) Designated Hazard Areas

The structures immediately adjacent to Red Butte Creek are the only ones only remotely vulnerable to impact due to flooding.

In the University's best judgment, there is no cause to implement of any pre-disaster mitigation actions designed to mitigate the impact of flooding due to natural causes, given the extremely low likelihood of occurrence and the minimal impacts even if/when it does happen. Instead, more is to be gained to prepare for this type of event through the identification of the most effective preparation and response strategies, by those entities directly in the potential path of such floods.

D.3.4.1(g)(i) Buildings at risk. Listed by number, name, daytime occupancy, and exposure in thousands of dollars.

Table 13: Buildings at risk for flood damage

§201.6(c)(2)(i)B

Number	Name	Occup. (day)	Exposure
323	Greenhouse	0	unknown
324	Horticulture Garage	0	unknown
327	PPO Greenhouse	0	unknown
329	East Greenhouse & Office	1	unknown
665	Fort Douglas 665	10	$415,000.00
666	Fort Douglas 666	10	$8,395,000.00
720	Student Apts Maintenance	0	$1,627,000.00
727	Univer Village West 200B	8	$1,639,000.00
728	Univer Village West 200C	8	$1,639,000.00
750	Univer Village West 800A	63	$3,713,000.00
751	Univer Village West 800B	69	$3,713,000.00
752	Univer Village West 800C	68	$3,713,000.00
753	Univer Village West 900A	67	$3,713,000.00
754	Univer Village West 900B	67	$3,713,000.00
755	Univer Village West 900C	58	$3,713,000.00
851	UU Orthopedic Center	286	$436,891,000.00
853	Health Professions Education	226	$10,088,000.00
855	480 Wakara Way	unknown	Unknown
858	420 Wakara Way	91	$165,000.00
863	390 Wakara Way	unknown	Unknown
865	295 Chipeta Way	545	$673,000.00
	Total	**1510 people**	**$483,810,000.00**

D.3.4.2 Dam Failure

D.3.4.2(a) Summary of Risk Factors

Table 14: Summary of risk factors: dam failure

	Day-to-day	Catastrophic
Period of occurrence:	Potentially annually	Unknown
Probability of event(s):	Low	Low
Warning time:	Hours	None

Major contributor(s):	Spring runoff, heavy precipitation	Earthquake, terrorism
Risk of injury?	Low	Low
Potential for facilities shutdown?	Low	Low
Percent of affected properties that may be destroyed or suffer major damage:	0%	<10%

D.3.4.2(b) Hazard Profile Data

Dam failure can be caused by a variety of influences, ranging from earthquakes to excessive precipitation, poor design and/or maintenance, and of course, terrorism. The State Engineer's office has the responsibility for monitoring dam safety of all non-federal dams in Utah. (The performance of federal dams is monitored in accordance with the *Safety of Dams Act*, which encompasses two separate programs, the *Safety Evaluation of Existing Dams* (SEED) Program, and the *Safety of Dams* (SOD) Program.)

D.3.4.2(c) Background and Local Conditions

The State Pre-Disaster Mitigation Plan (2004) indicates that of the 900+ dams that fall under the jurisdiction of the state, more than 20% were assigned a high hazard rating.

In 1989, the Quail Creek Dam ruptured. Located near St. George in south-western Utah's rural areas, this event sent a giant wave of water and mud down the Virgin River, flooding an estimated 30 homes, numerous apartment dwellings and nine businesses located adjacent to the Virgin. This is the only reported incident of a dam inundation reported in the State of Utah's Pre-Disaster Mitigation Plan of 2004.

Red Butte Dam, east of the University of Utah's campus, has imposed a perception of risk since it was constructed 75 years ago. According to Central Utah Water Conservation District (CUWCD) reports, Red Butte Dam was in fact at some risk until recently. There is no recorded history reported by any of the agencies previously associated to or with an interest in the dam indicating failure or damage associated with dam failure or leakage. An infusion of federal funds recently renovated the dam, spillway, and monitoring systems to where it is no longer considered to be at risk.

D.3.4.2(d) Historic Frequency and Probability of Occurrence

There is no history of dam failure or subsequent incidents of dam inundation associated with the Red Butte Dam, located east of and above the University of Utah, between the date of its original construction and 2008. (For further information, refer to: http://waterrights.utah.gov/.)

D.3.4.2(e) Severity

Dam inundation studies conducted by the Department of Defense (1986) with focus on Red Butte Dam concluded that there is a slight risk of flooding associated with potential dam failure and subsequent inundation, especially as it pertains to properties to the west of Foothill Boulevard. In this general area, the natural grade is less steep than it is further east. University Student Apartments, located to the south of the Red Butte Creek and west of Foothill Drive, are exposed to the possibility that structures closest to the channel may experience some flooding and suffer minimal damage. This could be particularly true for some of the basement level apartments.

Current maps, available at the State Engineer’s office, indicate that flooding as the result of dam inundation holds the potential of impacting several University owned structures east of Foothill and south of Red Butte Creek, in the area between Wakara and Red Butte Creek. Resulting flooding could impact facilities such as the new Orthopedics Hospital and the Williams building at ground level or below, primarily on the northeast corner of each.

This type of flood could potentially minimally affect the student apartments at Sage Point and some of the assets in the Red Butte Gardens. The amount of impact will be directly related to the amount of water in storage at Red Butte reservoir at the time, along with coincidental prevailing weather conditions.

Although there is a minor risk of limited damage to property, there is no anticipation that there will be any fatalities associated with this type of event.

D.3.4.2(f) Historic Losses and Impacts

Since there have not been any reports of events of this nature, there are no records of any losses or other impacts associated with dam inundations.

In the University’s best judgment, the lack of significant threat from this source does not warrant implementation of any pre-disaster mitigation actions, particularly since the completion of restoration of the Red Butte Dam.

Managers of entities located in the hazard zone should feel encouraged to prepare for this type of event (however unlikely) through the identification of effective preparation, notification, and response and business resumption strategies.

D.3.4.2(g) Designated Hazard Areas

The designated hazard areas are limited to zones on both sides of Red Butte Creek, from the mouth of the Red Butte Canyon to Sunnyside Drive, as shown in *Map 9: Dam failure*.

D.3.5 Severe Weather

D.3.5.1 Summary of Risk Factors

§201.6(c)(2)(ii)

Table 15: Summary of risk factors: severe weather

	Lightning	**High winds**	**Extreme Temperatures**	**Heavy Snow**
Period of occurrence:	Annually	Annually	Annually	Annually
Probability of event(s):	Moderate	Moderate	Low	Moderate
Warning time:	None	Hours	Days	Days
Major contributor(s):	Thunderstorms	Rapid change in air pressure	Climate change	High winds and precipitation
Risk of injury?	Moderate	Low	Low	Moderate
Potential for facilities shutdown?	None	Low	Moderate	Moderate
Percent of affected properties that may be destroyed or suffer major damage:	<1%	<1%	<1%	<1%

D.3.5.2 Hazard Profile Data

Because of the relative low number and effect on campus of severe weather events, hazard profile data for severe weather events found in this strategy correlates with that found in the State of Utah Mitigation Plan.

D.3.5.2(a) Lightning is the discharge of electricity induced as negative and positive charges build up in a cloud system during the development of a thunderstorm. Some forms of this discharge are directed toward the ground and may hit buildings, trees, and people.

D.3.5.2(b) High winds, including localized events called downbursts, may occur during a thunderstorm or at other times of rapid changes in air pressure. High winds may down trees or power lines. Microbursts can also have significant impact on property.

D.3.5.2(c) Extreme temperatures include both hot and cold temperatures much greater than seasonal expectations. With Utah's desert climate, we are susceptible to both forms of extreme temperature. Effects can be felt among all populations, particularly the very young or very old, or those with chronic health conditions. Temperatures can vary by 30 to 40 degrees in a single 24-hour period.

D.3.5.2(d) Severe winter storms may bring heavy snow, ice, strong winds and freezing rain. Winter storms can prevent people from traveling to and from work or school, leading to temporary shutdowns. Structural damage, power outages, and people slipping on snow or ice are also risk factors

D.3.5.3 Background and Local Conditions

D.3.5.3(a) Lightning strikes in the Salt Lake County since 1950 have injured 41 people out of 139 statewide. There is no data available indicating that any strikes have occurred on campus, although institutional memory indicates that such an event has never been reported.

D.3.5.3(b) High winds on campus are of little difference compared with elsewhere in the county. The campus' proximity to the foothills does tend to amplify our exposure to high winds, although typically not significantly, and infrequently.

D.3.5.3(c) Our large student population who are outdoors and mobile throughout the day exacerbates the impact of extreme temperatures on campus.

D.3.5.3(d) Heavy snow is a common occurrence during winters along the Wasatch Front. Easterly winds crossing Utah collide with the mountains (an orthographic barrier) causing precipitation to be dropped on the East Benches, including most of campus.

D.3.5.4 Historic Frequency and Probability of Occurrence

D.3.5.4(a) Lightning – While probability is high, there is no reported data for the number of lightning strikes on campus.

D.3.5.4(b) High winds may occur annually in the spring and fall. No known data for the number of microbursts on campus is available.

D.3.5.4(c) Extreme temperatures – Most recent history records that electrical systems in 2004 were challenged to keep up with demand associated with cooling loads. The main source of heat for the campus' buildings, the HTHW Plants, relies on natural gas purchased and delivered on an uninterruptible rate schedule. They both have a back-up fuel should natural gas delivery be interrupted for other reasons. There has not been an interruption for several decades.

D.3.5.4(d) Heavy snow is a possibility during every winter, with extremely heavy snowfall having occurred every few years. Recent history records severe winter storms in 1964, 1984, 1988, and 1993.

D.3.5.5 Severity

D.3.5.5(a) Lightning – The Office of Risk Management at the University of Utah has a record of a small number of lightning strikes over the last 50 years. There is no history of any personal injuries resulting directly from lightning strikes.

D.3.5.5(b) High winds – There are many and fairly frequent instances of winds with high velocity crossing the campus, primarily and most commonly out of the canyons to the east of the campus. In 1993, and several winters in following years, winds in excess of 100 mph were reported at campus monitoring stations.

D.3.5.5(c) Extreme temperatures – Particularly in the summer months, the demand for electric power may exceed supply. This is not so much a result of the University's distribution system, in the vast majority of cases, as it is availability of the commodity in Rocky Mountain Power's distribution system. Such was the case most recently in 2004. There has not been an extended curtailment of natural gas supply to the central heating plants for the campus in the last two decades.

D.3.5.5(d) Heavy snow – In the last 45-50 years, the University has only had to shut down for business a few times. Anecdotes indicate that the *total* for such closures is no more than six full days, with the maximum single event lasting no more than one to two days.

D.3.5.6 Historic Losses and Impacts

D.3.5.6(a) Lightning – There have been some reported instances of damage to on-campus electronics and communications as a result of lightning strikes. The electric distribution system serving the main campus has also experienced some strikes and damage. No personal injuries have been reported.

D.3.5.6(b) High winds – While no reports of personal casualties exist in the files of Risk Management at the University, there have been reports of damage to some facilities (primarily the air supported structure over the football training field) and to numerous trees. The cost for replacing the air structure was in excess of $300,000. There is no trackable dollar loss associated with any tree damage, since there is no insurance coverage for such events. Similar situations have existed, on occasion, with temporary power or heat outages during some winters, when isolated buildings may have been briefly at risk of or actually having endured minor damage from "freezing," typically as the result of human error or negligence. Fortunately, this has never become a serious issue—primarily as a result of redundancies built into many of the University's facilities, supported by a 7-24 emergency response plan by its maintenance and operations divisions.

D.3.5.6(c) Extreme temperatures – While no casualties have been directly reported as a result of electric "brown-outs," there have been reports of temporary illness, reduction of productivity and ability to teach/learn. There have also been *unsubstantiated* reports of research projects having been severely impacted by power outages, including those triggered by either wind or extreme temperatures.

D.3.5.6(d) Heavy snow – There have been a handful of occasions when the administration elected to allow personnel to come into campus later than normal, or to send non-essential staff home before normal quitting time—mostly with the intent of helping the surrounding community manage traffic while allowing its own crews to remove snow and ice from essential roadways and pedestrian areas. There are filed reports of slip and fall accidents almost every year, in spite of the University's excellent track record in managing its snow and ice removal programs.

D.3.5.7 Designated Hazard Areas

D.3.5.7(a) Lightning – none.

D.3.5.7(b) High winds – none.

D.3.5.7(c) Extreme temperatures – none

D.3.5.7(d) Heavy snow – none, although the east side of campus is more vulnerable than is the western half.

D.3.6 Wildfire

D.3.6.1 Summary of Risk Factors

§201.6(c)(2)(ii)

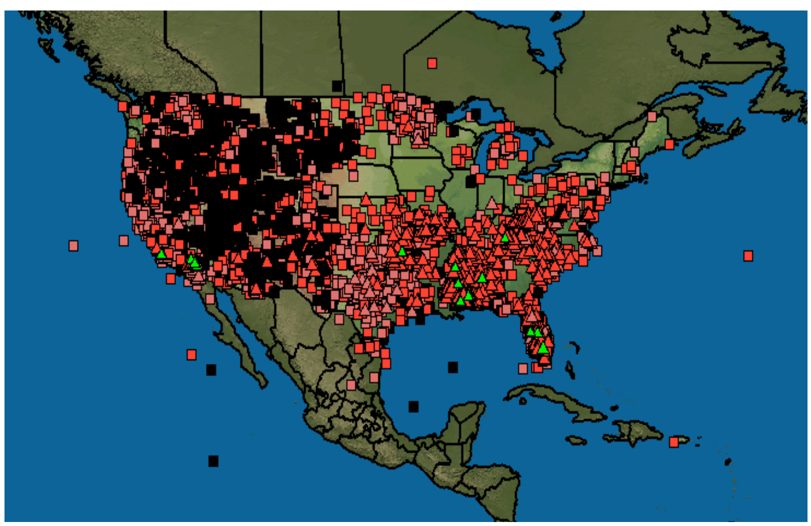
Table 16: Summary of risk factors: wildfire

	Day-to-day	Catastrophic
Period of occurrence:	Potentially annually	Low
Probability of event(s):	Moderate to Low	Low
Warning time:	Hours	Hours
Major contributor(s):	Wet spring followed by a dry, hot summer; people; lightning	Wet spring followed by a dry, hot summer; people; lightning
Risk of injury?	None	Low
Potential for facilities shutdown?	None	Low
Percent of affected properties that may be destroyed or suffer major damage:	0%	<5%

D.3.6.2 Hazard Profile Data

The information that is graphically displayed on the following maps is based on data provided by Geospatial Multi-Agency Coordination (GEOMAC). The probable causes for the reported fires are either represented as *people caused* or *unknown* (red markers) or *lightning caused* (black markers). The markers the map below demonstrate that there are areas in the United States where wildfires occur with much greater frequency than is experienced in Utah, and certainly in this part of the state.

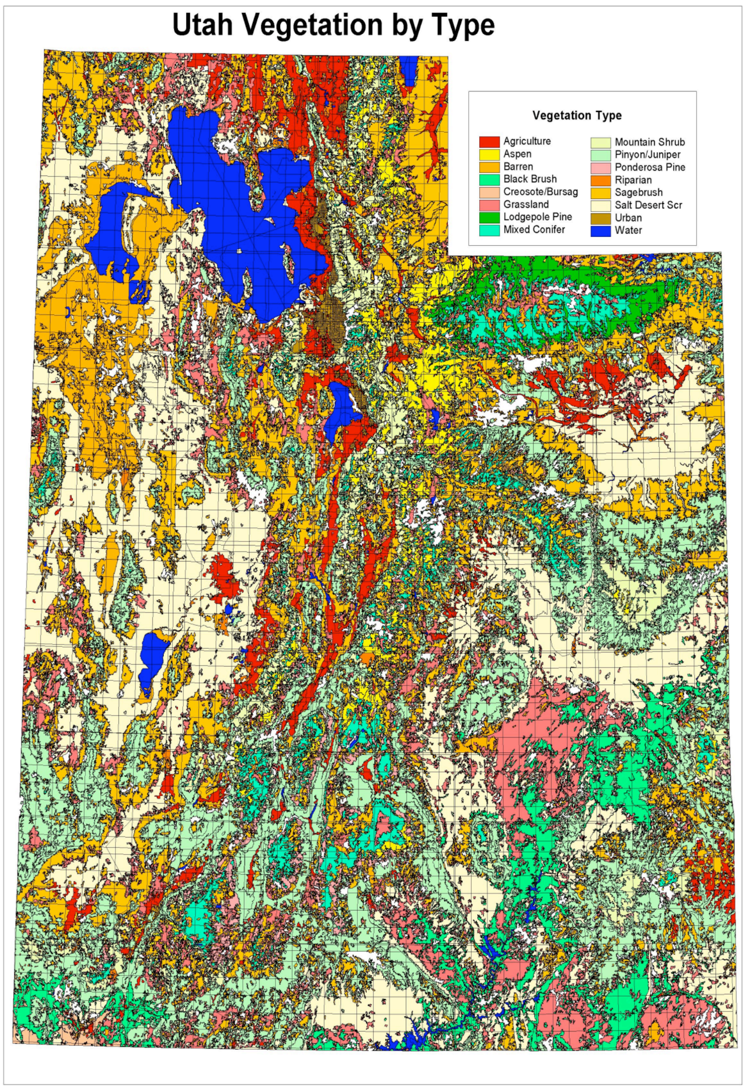
Map 2: Wildfires caused by lightning strikes and people (Source: GEOMAC)



Lightning is the culprit for causing the majority of wildfires in the western United States. In fact, the majority of the wildfires occurring in Utah are the result of lightning strikes. Conversely, the wildfires reported east of Denver are generally more frequently the result either of human activities or unknown causes.

Utah is generally considered to be in a very dry and arid climate. The types of vegetation found in much of the state, with the exception of in the developed and urban areas, provide an unfortunately very hospitable site for potential wildfires. The following map identifies the types of vegetation found throughout the state.

Map 3: Utah vegetation by type

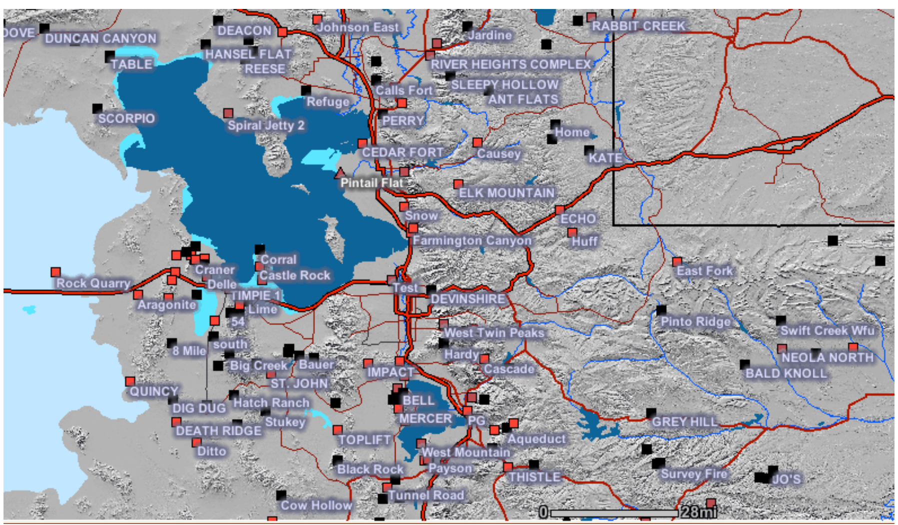


According to the Utah Division of Emergency Services and Homeland Security the Wasatch Front is a prime example of a classic wildland interface zone. The University of Utah's main campus is located in this zone, classified as the Classic Interface Area under the Urban-Wildland classification. In this zone, structures are in close proximity to wildland vegetation. This is true for the entire eastern margin of the campus at the University of Utah. As described in **Section C** in this document, each spring the vegetation in this area evolves into a ready fuel for wildfires, only waiting for something (or someone) to ignite it.

D.3.6.3 <u>Background and Local Conditions</u>

The map below shows wildfires reported by the offices of Geospatial Multi-Agency Coordination (GEOMAC) for this part of the state since 2002 (See http://geomac.usgs.gov/).

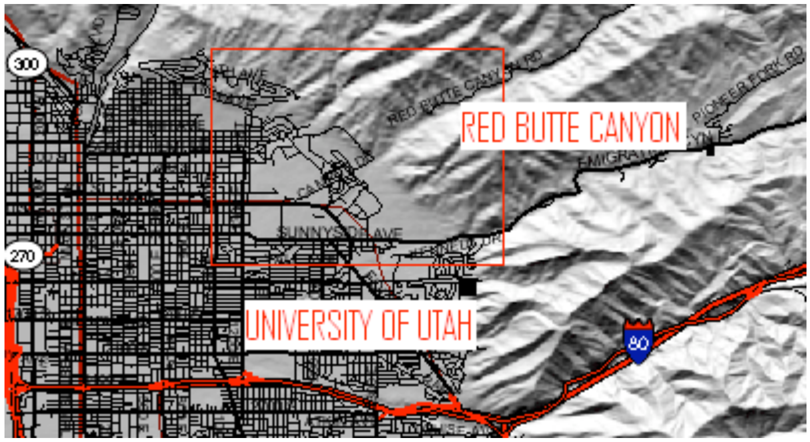
Map 4: Reported wildfires in Utah from 2002
(Source: GEOMAC)



The University of Utah is located on the northeast bench of the Salt Lake Valley, against the foothills of the Wasatch Mountains. These foothills are extensively vegetated with native grasses and other types of plants that change from relatively lush and green to dry and brown. In a typical year, this drying out occurs as early as late May or June.

The map below shows the proximity of the University of Utah to the adjacent foothills. The campus appears as the triangular-shaped light gray area, above or north of the street labeled as "Sunnyside Ave."

Map 5: Proximity of campus to foothills (Source: GEOMACt)



After winters with below average precipitation, the risk of wildfires evolves much earlier in the year. Conversely, an exceptionally wet winter will stimulate additional and thicker growth of vegetation. Even though fire season may then start later in the season, an untimely wildfire could be more severe as it takes advantage of the additional fuel.

D.3.6.4 Historic Frequency and Probability of Occurrence

Based on vulnerability rankings using as a yardstick the number of square miles of high or extremely high vulnerability to wildfires, Salt Lake County is ranked 27th out of 29 counties. Obviously, this also reflects on the vulnerability of the University of Utah, located in Salt Lake County.

The School Land Trust in Utah owns approximately 3.3 million acres of mostly undeveloped property across the state. The University of Utah is a substantial stakeholder in this Trust. Some properties have been minimally impacted by fires in those remote areas, but without any serious threat being posed on the University's people or assets, and without any reports of casualties or loss of assets. No reports were recorded by GEOMAC relating to any significant events impacting lands or assets controlled by the University of Utah.

Individuals associated with the campus in the past may remember the 1960s fire on the hillside around the Block U. Several decades ago, the hillsides and ridges several miles up Emigration Canyon were in flames, threatening homes in the canyons as the fires raced south toward Parleys Canyon. That fire did not constitute a threat to any asset or individual associated with the University of Utah.

During the last two decades, two fires occurred in Red Butte Canyon, on U.S. Forest Service property. Both of these fires were contained relatively quickly through the efficient response of firefighters, and neither presented an immediate threat to University property or personnel, although at least one caused a great deal of anxiety on the part of staff at Red Butte Gardens. However, prevailing winds at the time reversed themselves on a timely basis, driving the flames and smoke back uphill and away from the Gardens' assets.

It is a matter of interest to recognize that none of the fires that were close to the University was caused by lightning—each one was reported as resulting from human activity.

Individuals familiar with recent campus events may recall that there was a small fire reported, in 2006, in the area of the Lime Kilns (located north of and away from the main campus in a predominantly residential area). It was not considered a wildfire, as it was mostly confined to some debris and vegetation within the kilns themselves. Allegedly, careless individuals hosting a clandestine party at the site ignited it.

Officials at the University of Utah are sensitive to the reality that the campus is bordered on its eastern edge by dry grasses and other vegetation, and that at any time during every summer a wildfire could occur in this neighborhood. This potential is further emphasized by the frequent and high use of the Bonneville Shoreline Trail by thousands of individuals during the course of the year, whether on foot or on bike. The University routinely enforces its posted policy prohibiting the unauthorized use of motorized vehicles on its section of the Trail, and subordinate trails.

These trails provide open access to anyone wanting to use them, including during the July 4th celebrations. Although discouraged, it is not unusual for families to spend considerable time on the trail during the late evening of July 4th, watching the official fireworks displays around the valley and occasionally setting off some of their own (legal or otherwise). Risk is omnipresent.

D.3.6.5 Severity

There have been no reports of wildfires directly impacting assets or populations associated with the University of Utah. Therefore, the potential severity of such events is considered to be extremely minimal.

D.3.6.6 Historic Losses and Impacts

The University's Office of Risk Management has reported no losses due to wildfire.

Unfortunately, we were not able to locate any modeling tools to guide us in calculating structural damage or casualties as a result of wildfires. Given the University's fortunate history with wildfires, however, it is prudent to presume that any damage will be minimal, with no deaths or other casualties resulting from any such event. Reasonable precautions and communication channels are in place to help assure these continued successes.

D.3.6.7 Designated Hazard Areas

The recognized hazard area extends along the eastern edge of the University of Utah, beginning at Tomahawk Drive to the north and terminating near *This is the Place State Park*, to the south. University facilities such as the Regulated Waste Facility and properties at the Red Butte Gardens are certainly close to where the action could be, but benefit from effective incorporation of fire fighting systems and dedicated management plans.

To eradicate any threat to its buildings, programs, and people, the University requires adequate safe zones between its buildings and the natural terrain. During the design and construction of all new facilities in this area, all pertinent fire codes are met or exceeded. This applies to the growing Huntsman Cancer complex as well as the new Utah Museum of Natural History (UMNH) facility. The latter is about to enter into the construction phase. University planners who are aware of the wildfire risk in this area were deeply involved in causing the design of this building and the layout of its site to be as "wildfire proof" as possible.

The University insists on assuring that firefighters will have reasonable access to any corner of every structure and that they will be able to pull adequate water from firefighting systems.

D.3.7 Terrorism

D.3.7.1 Summary of Risk Factors

§201.6(c)(2)(ii)

Table 17: Summary of risk factors: terrorism

Period of occurrence:	Random
Probability of event(s):	Believed to be low, currently
Warning time:	Very short, though sometimes threats

	precede violence.
Major contributor(s):	Unpopular policies, research practices
Risk of injury?	High
Potential for facilities shutdown?	High
Percent of affected properties that may be destroyed or suffer major damage:	<1%

D.3.7.2 Hazard Profile Data

The FBI defines *terrorism* as the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population or any segment thereof, in furtherance of political or social objectives. *Domestic terrorism* is that unlawful use or threat of use of force or violence by a group or individual based and operating entirely within the United States. *International terrorism* is that unlawful use of force or violence committed by a group or individual having some connection to a foreign power or whose activities transcend national boundaries.

At its core, terrorism seeks to gain recognition, coerce, intimidate and/or provocation. Tactics include any weapon or device that is intended, or has the capability, to cause death or serious bodily injury to a significant number of people through the release, dissemination, or impact of toxic or poisonous chemicals or their precursors; a disease organism, or radiation or radio-activity; any explosive, incendiary or poison gas, bomb, grenade or rocket have a propellant charge of more than four ounces, or a missile having an explosive or incendiary charge of more than one quarter ounce, or mine or device similar to the above; poison gas; any weapon that is designed to release radiation or radioactivity; any weapon involving a disease organism.

Terrorist goals appear to be increased body counts of their perceived enemies, creation of public anxiety and undermined confidence in government. To further complicate planning efforts, international terrorists often opt for martyrdom rather than survival.

The FBI further defines *potential threat element(s)* (PTE) as any individual or any group of individuals regarding whom there are allegations or information indicating the possibility of the unlawful use of force or violence. When such information is viable it will provide cause for investigation. An analysis of motivations provides insight into the specific sites at the University in which a PTE might have an interest. Any such sites that exist at the University of Utah are considered by experts to be low-risk when contrasted with similar or other sites at other institutions, elsewhere in the United States.

D.3.7.3 Background and Local Conditions

There have been no international terrorist attacks on or in Utah.

D.3.7.4 Historic Frequency and Probability of Occurrence

Worldwide, more than 14,000 international terrorist attacks have occurred since 1968. In the past 10 years, there have been three successful terrorism attacks in the US: 1993 World Trade Center, 2001 World Trade Center and Pentagon. None have occurred in Utah.

D.3.7.5 Severity

Potentially high.

D.3.7.6 Historic Losses and Impacts

None.

D.3.7.7 Designated Hazard Areas

None.

D.3.8 Random Acts of Violence

D.3.8.1 Summary of Risk Factors

§201.6(c)(2)(ii)

Table 18: Summary of risk factors: random acts of violence

Period of occurrence:	Random
Probability of event(s):	Low to Moderate
Warning time:	Short – though suicide threats are sometimes made prior to acts of violence.
Major contributor(s):	Among the general behavioral commonalities, difficulty coping with significant losses or personal failures (mostly perceived failures), access to and prior use of weapons prior to the attack, and a history of suicide attempts or suicidal thoughts.
Risk of injury?	Moderate
Potential for facilities shutdown?	Moderate
Percent of affected properties that may be destroyed or suffer major damage:	Low

D.3.8.2 Hazard Profile Data

Violence between strangers, among acquaintances, and in relationships is present on college and university campuses as in society. In light of institutional commitments to education, development, and personal safety of individuals, acts of violence on campus are particularly damaging. Persons and institutions are harmed, sometimes in irreparable ways. Assault, rape, abuse, harassment, and other behaviors inappropriate in civilized society and in a learning environment are included in this category.

There are a number of unique factors that contribute to persons becoming victims of acts of violence: youthful indiscretion and lack of judgment are present; freedom of expression frequent means freedom to experiment behaviorally; the very open physical environment; the more people present, the greater the opportunity for impersonal experiences and increases in a sense of insignificance; small campuses may experience rumor mills and pressure cooker intensity.

D.3.8.3 Background and Local Conditions

The University of Utah has had some acts of violence reported during the last fifty years. There have been several suicides, as well as sexual assaults, rapes and other violent assaults. No reports exist of shootings on the campus.

The most common type of event is related to burglary, both automotive and through intrusion into office spaces. There have also been several reports of armed robbery in recent years, but none resulting in personal injury

D.3.8.4 Historic Frequency and Probability of Occurrence

According to the Violent Victimization of College Students report (Baum & Klaus, 2005), between 1995 and 2002, college students ages 18-24 were victims of approximately 479,000 crimes of violence annually: rape/sexual assault, robbery, aggravated assault, and simple assault.

According to the Department of Education, collection of the crime data began in 1999, and now extends to 2001, with the figures for 2002 scheduled for release in July 2008. With only three years of data in hand, sociologists have generally conceded that more reporting would be necessary to discern any trends in crime. A superficial analysis of campuses across the country, however, suggests that reports of aggravated assaults fell 3.7 percent during the three years, while forcible sexual offenses steadily increased, by 14 percent. The number of campus murders also rose, to 18 in 2001 from 11 in 1999.

D.3.8.5 Severity

Alcohol and burglary offenses lead the list of University of Utah violence hazards.

D.3.8.6 Historic Losses and Impacts

The University of Utah crime statistics are collected and maintained by University Police. Data for 2005 and 2006 is available here: http://www.uupd.utah.edu/CCS.dwt.

D.3.8.7 Designated Hazard Areas

None.

E. Recommended Hazard Mitigation Actions

Recently, leadership at the University of Utah initiated an intentional effort to de-emphasize official *policies*, choosing to rely instead on *guidelines* and *processes* which are result-driven. A document such as this one is most likely to achieve its desired result when it is constructed upon the spirit of offering *suggestions* and *recommendations*, rather than pretending to issue strongly worded mandates. This approach falls closely in line with the University of Utah's decision to consider the culmination of this Pre-Disaster Mitigation project as an articulated and continuously evolving set of *recommended actions*, the assimilation of which will help this institution realize the enviable status of becoming a Disaster Resistant University.

§201.6(c)(3)(ii)

For ease of reading, the following legend explains the possible status levels as associated with each **item (d)**, as shown in the outline that follows.

Stage 1: Waiting for decision or commitment by responsible authority
Stage 2: Seeking or awaiting funding
Stage 3: Ready for initial implementation
Stage 4: Early stages of implementation; perhaps as the result of pre-existing processes
Stage 5: Implemented; will continue to benefit from continuous change and improvements

Details on the positions and titles listed in the Accountability component of each mitigation action are found in *Section B.2.2.2 Administration Organizational Chart.*

E.1 All Categories: Earthquake, Wildfire, Floods and Inundation, Pandemics, and Human Caused Events

E.1.1 Enterprise level

E.1.1.1 Assign responsibility for leading mitigation planning efforts on campus.

E.1.1.1(a) Target Goals: Preserve life safety; protect University assets and investments; protect critical response facilities.

E.1.1.1(b) Priority: High

E.1.1.1(c) Timing: Short-term

E.1.1.1(d) Accountability

E.1.1.1(d)(i) Vice President, Administrative Services

E.1.1.1(d)(ii) Associate Vice President, Facilities

E.1.1.1(d)(iii) Director Space Planning and Management
E.1.1.1(d)(iv) Director Environmental Health and Safety

E.1.1.1(e) Current Status: Stage 1

E.1.1.2 <u>Revisit and update the mitigation plan at least once every five years as a component of the campus' master planning process.</u>

E.1.1.2(a) Target Goals: Preserve life safety; protect University assets and investments

E.1.1.2(b) Priority: High

E.1.1.2(c) Timing: Long-term

E.1.1.2(d) Accountability:
E.1.1.2(d)(i) Vice President, Administrative Services
E.1.1.2(d)(ii) Associate Vice President, Facilities
E.1.1.2(d)(iii) Director, Environmental Health and Safety

E.1.1.2(e) Current Status: Stage 3

E.1.1.3 <u>Design and make available training programs designed to educate campus constituents on comprehensive emergency management.</u>

E.1.1.3(a) Target Goals: Preserve life safety; protect University assets and investments

E.1.1.3(b) Priority: High

E.1.1.3(c) Timing: Perpetual

E.1.1.3(d) Accountability:
E.1.1.3(d)(i) Vice President, Administrative Services
E.1.1.3(d)(ii) Special Assistant for Emergency Management
E.1.1.3(d)(iii) Director, Environmental Health and Safety

E.1.1.3(e) Current Status: Stage 2

E.1.1.4 <u>Ensure that the capital improvement prioritization process includes seismic upgrades.</u>

E.1.1.4(a) Target Goals: Preserve life safety; protect University assets and investments; protect critical response facilities.

E.1.1.4(b) Priority: High

E.1.1.4(c) Timing: Perpetual

E.1.1.4(d) Accountability:
- E.1.1.4(d)(i) Senior Vice President, Academic Affairs
- E.1.1.4(d)(ii) Vice President, Administrative Services
- E.1.1.4(d)(iii) Associate Vice President, Facilities

E.1.1.4(e) Current Status: Stages 2, 4

E.1.2 Departmental Level

E.1.2.1 Conduct a department-wide risk assessment to identify falling hazards, potential hazardous material spills and other hazards that would impact rapid evacuation.

E.1.2.1(a) Target Goals: Preserve life safety; protect University assets and investments

E.1.2.1(b) Priority: High

E.1.2.1(c) Timing: Short-term; Perpetual

E.1.2.1(d) Accountability:
- E.1.2.1(d)(i) Deans, Chairs, Directors
- E.1.2.1(d)(ii) Senior Vice President, Academic Affairs
- E.1.2.1(d)(iii) Director, Environmental Health and Safety
- E.1.2.1(d)(iv) Special Assistant for Emergency Management

E.1.2.1(e) Current Status: Stage 1

E.1.2.2 Identify high value assets at risk of loss and move them to safety

E.1.2.2(a) Target Goals: Preserve life safety; protect University assets and investments

E.1.2.2(b) Priority: High

E.1.2.2(c) Timing: Short-term; Perpetual

E.1.2.2(d) Accountability:
- E.1.2.2(d)(i) Deans, Chairs, Directors
- E.1.2.2(d)(ii) Senior Vice President, Academic Affairs

E.1.2.2(d)(iii) Director, Environmental Health and Safety

E.1.2.2(d)(iv) Manager, Risk and Insurance Management

E.1.2.2(e) Current Status: Stage 1

E.1.2.3 Evolve the mitigation efforts in the department into a comprehensive emergency management committee to coordinate efforts college-wide during 2010

E.1.2.3(a) Target Goals: Preserve life safety; protect University assets and investments

E.1.2.3(b) Priority: High

E.1.2.3(c) Timing: Short-term; Perpetual

E.1.2.3(d) Accountability:

E.1.2.3(d)(i) Deans, Chairs, Directors

E.1.2.3(d)(ii) Senior Vice President, Academic Affairs

E.1.2.3(d)(iii) Director, Environmental Health and Safety

E.1.2.3(d)(iv) Special Assistant for Emergency Management

E.1.2.3(e) Current Status: Stage 1

E.1.2.4 Appoint a mitigation coordinator in each department to review mitigation actions affecting contents of specific buildings. ("Contents" refers to furnishings and personal items, etc.).

E.1.2.4(a) Target Goals: Preserve life safety; protect University assets and investments; protect critical response facilities.

E.1.2.4(b) Priority: High

E.1.2.4(c) Timing: Short-term; Perpetual

E.1.2.4(d) Accountability:

E.1.2.4(d)(i) Deans, Chairs, Directors

E.1.2.4(e) Current Status: Stage 1

E.1.2.5 Conduct a non-structural risk assessment of departmental spaces in 2009-2010. Identify high-profile filing cabinets and other freestanding shelves to bolt to walls; identify fixed-shelves over workstations; identify other heavy or valuable objects above shoulder-height.

E.1.2.5(a) Target Goals: Preserve life safety; protect University assets and investments

E.1.2.5(b) Priority: High

E.1.2.5(c) Timing: Short-term; Perpetual

E.1.2.5(d) Accountability:

E.1.2.5(d)(i) Deans, Chairs, Directors

E.1.2.5(e) Current Status: Stage 1

E.1.2.6 <u>From departmental risk assessments, prioritize mitigation actions and implement them as resources and policies permit where the department will obtain the “biggest bang for your buck.”</u>

E.1.2.6(a) Target Goals: Preserve life safety; protect University assets and investments

E.1.2.6(b) Priority: High

E.1.2.6(c) Timing: Perpetual

E.1.2.6(d) Accountability:

E.1.2.6(d)(i) Deans, Chairs, Directors

E.1.2.6(e) Current Status: Stage 1

E.1.2.7 <u>Discourage individuals from bringing personal items into workspaces that they do not wish to have damaged or lost.</u>

E.1.2.7(a) Target Goals: Protect University assets and investments

E.1.2.7(b) Priority: Medium

E.1.2.7(c) Timing: Perpetual

E.1.2.7(d) Accountability:

E.1.2.7(d)(i) Deans, Chairs, Directors

E.1.2.7(d)(ii) Director, Environmental Health and Safety

E.1.2.7(d)(iii) Manager, Risk Management

E.1.2.7(e) Current Status: Stage 4

E.1.2.8 Direct faculty and staff (especially essential personnel) to create a personal emergency kit.

E.1.2.8(a) Target Goals: Preserve life safety

E.1.2.8(b) Priority: High

E.1.2.8(c) Timing: Short-term; perpetual

E.1.2.8(d) Accountability:

E.1.2.8(d)(i) Deans, Chairs, Directors

E.1.2.8(d)(ii) Special Assistant for Emergency Management

E.1.2.8(d)(iii) Manager, Risk Management

E.1.2.8(e) Current Status: Stage 4

E.2 Category: Earthquake

E.2.1 Enterprise level

E.2.1.1 Evaluate the location of essential functions with regard to earthquake survivability during 2010- 2011.

E.2.1.1(a) Target Goals: Preserve life safety; protect University assets and investments

E.2.1.1(b) Priority: High

E.2.1.1(c) Timing: Short-term

E.2.1.1(d) Accountability

E.2.1.1(d)(i) Vice President Administration in consultation with the President's Cabinet

E.2.1.1(d)(ii) Deans, Chairs, Directors

E.2.1.1(d)(iii) Associate Vice President, Facilities

E.2.1.1(e) Current Status: Stage 2, 5

E.2.1.2 Identify all buildings with unrestrained mechanical equipment, etc. on rooftops; place each on a funding-needed list for mitigation.

E.2.1.2(a) Target Goals: Preserve life safety; protect University assets and investments

E.2.1.2(b) Priority: High

E.2.1.2(c) Timing: Short-term

E.2.1.2(d) Accountability:
E.2.1.2(d)(i) Associate Vice President, Facilities

E.2.1.2(e) Current Status: Stage 2, 5

E.2.1.3 <u>Identify at-risk utility lifelines to mission critical buildings.</u>

E.2.1.3(a) Target Goal: Protect University assets and investments

E.2.1.3(b) Priority: Medium

E.2.1.3(c) Timing: Long-term

E.2.1.3(d) Accountability:
E.2.1.3(d)(i) Associate Vice President, Facilities

E.2.1.3(e) Current Status: Stage 2, 3

E.2.2 Departmental Level

E.2.2.1 <u>Prohibit the installation of shelves over workspaces.</u>

E.2.2.1(a) Target Goal: Preserve life safety; protect University assets and investments

E.2.2.1(b) Priority: High

E.2.2.1(c) Timing: Short-term, Perpetual

E.2.2.1(d) Accountability:
E.2.2.1(d)(i) Deans, Chairs, Directors
E.2.2.1(d)(ii) Director, Environmental Health
E.2.2.1(d)(iii) Manager, Risk Management
E.2.2.1(d)(iv) Director, Plant Operations

E.2.2.1(e) Current Status: Stage 1

E.2.2.2 <u>Host earthquake awareness training for departmental faculty and staff during 2009-2010.</u>

E.2.2.2(a) Target Goal: Preserve life safety; protect University assets and investments

E.2.2.2(b) Priority: High

E.2.2.2(c) Timing: Short-term

E.2.2.2(d) Accountability:

E.2.2.2(d)(i) Deans, Chairs, Directors

E.2.2.2(d)(ii) Special Assistant for Emergency Management

E.2.2.2(d)(iii) Vice President, Student Affairs

E.2.2.2(e) Current Status: Stage 3

E.2.2.3 <u>Inventory hazardous materials in laboratories using the new campus web-based chemical inventory tool.</u>

E.2.2.3(a) Target Goals: Preserve life safety; protect University assets and investments

E.2.2.3(b) Priority: High

E.2.2.3(c) Timing: Short-term, Perpetual

E.2.2.3(d) Accountability:

E.2.2.3(d)(i) Deans, Chairs, Directors

E.2.2.3(d)(ii) Director, Environmental Health

E.2.2.3(e) Current Status: Stage 4

E.2.3 Individual Level

E.2.3.1 <u>Read the "Putting Down Roots in Earthquake Country" brochure (Utah version) during 2009-2010.</u>

E.2.3.1(a) Target Goal: Preserve life safety; protect University assets and investments

E.2.3.1(b) Priority: High

E.2.3.1(c) Timing: Short-term

E.2.3.1(d) Accountability:

E.2.3.1(d)(i) Each individual

E.2.3.1(d)(ii) Deans, Chairs, Directors, Administrators

E.2.3.1(e) Current Status: Stage 1

E.2.3.2 Examine your individual workspace, including common areas, and take action to move heavy objects from high shelves; bolt cabinets to walls; make sure evacuation routes are not blocked.

E.2.3.2(a) Target Goal: Preserve life safety; protect University assets and investments

E.2.3.2(b) Priority: High

E.2.3.2(c) Timing: Perpetual

E.2.3.2(d) Accountability:

E.2.3.2(d)(i) Each individual

E.2.3.2(d)(ii) Deans, Chairs, Directors, Administrators

E.2.3.2(e) Current Status: Stage 3

E.3 Category: Wildfire

E.3.1 Enterprise level

E.3.1.1 Develop a wildfire prevention and response plan.

E.3.1.1(a) Target Goal: Protect University assets and investments

E.3.1.1(b) Priority: Medium

E.3.1.1(c) Timing: Perpetual

E.3.1.1(d) Accountability:

E.3.1.1(d)(i) Director, Environmental Health and Safety

E.3.1.1(e) Current Status: Stage 5

E.3.1.2 Develop and/or review design guidelines and construction practices for the wildfire-urban interface, including opportunities to prohibit or limit new construction in those zones.

E.3.1.2(a) Target Goal: Protect University assets and investments

E.3.1.2(b) Priority: Medium

E.3.1.2(c) Timing: Perpetual

E.3.1.2(d) Accountability:
- E.3.1.2(d)(i) Associate Vice President, Facilities
- E.3.1.2(d)(ii) Director, Environmental Health and Safety

E.3.1.2(e) Current Status: Stage 5

E.3.1.3 <u>Evaluate the cost-benefit ratio of implementing a signage program aimed at reducing the risk of wildfires as a result of smoking, fireworks, open fires, etc. in at-risk areas.</u>

E.3.1.3(a) Target Goal: Protect University assets and investments

E.3.1.3(b) Priority: High

E.3.1.3(c) Timing: Perpetual

E.3.1.3(d) Accountability:
- E.3.1.3(d)(i) Associate Vice President, Facilities
- E.3.1.3(d)(ii) Director, Environmental Health and Safety

E.3.1.3(e) Current Status: Stage 4

E.3.2 Department Level

There are currently no recommended *department-level* mitigation actions for wildfire.

E.3.3 Individual Level

E.3.3.1 <u>Become aware of undeveloped and grassy areas surrounding the university that are locations for urban wildfires, and don't start fires in these areas.</u>

E.3.3.1(a) Target Goal: Protect University assets and investments

E.3.3.1(b) Priority: Low

E.3.3.1(c) Time-line: Perpetual

E.3.3.1(d) Accountability:
- E.3.3.1(d)(i) Each individual
- E.3.3.1(d)(ii) Special Assistant for Emergency Management

E.3.3.1(e) Current Status: Stage 1

E.3.3.2 Report fire hazards you observe to University Police.

E.3.3.2(a) Target Goal: Protect University assets and investments

E.3.3.2(b) Priority: Low

E.3.3.2(c) Timing: Perpetual

E.3.3.2(d) Accountability:
E.3.3.2(d)(i) Each individual

E.3.3.2(e) Current Status: Stage 1

E.4 Category: Floods and Inundation

E.4.1 Enterprise Level

E.4.1.1 Provide flood-plain estimates to managers of buildings along Red Butte Creek.

E.4.1.1(a) Target Goal: Protect University assets and investments

E.4.1.1(b) Priority: Low

E.4.1.1(c) Timing: Perpetual

E.4.1.1(d) Accountability:
E.4.1.1(d)(i) Director, Environmental Health and Safety
E.4.1.1(d)(ii) Director, Plant Operations

E.4.1.1(e) Current Status: Stage 3

E.4.1.2 Review the Red Butte Creek / Red Butte Dam management plans during 2009-2010 for possible action items.

E.4.1.2(a) Target Goal: Protect University assets and investments

E.4.1.2(b) Priority: Low

E.4.1.2(c) Timing: Perpetual

E.4.1.2(d) Accountability:
E.4.1.2(d)(i) Associate Vice President, Facilities

E.4.1.2(d)(ii) Director, Plant Operations
E.4.1.2(d)(iii) Director, Environmental Health and Safety

E.4.1.2(e) Current Status: Stage 4

E.4.2 Department Level

There are currently no recommended *department-level* mitigation actions for flood hazards.

E.4.3 Individual Level

E.4.3.1 Know where floods are likely and don't store irreplaceable items where they can be damaged -- especially in basements.

E.4.3.1(a) Target Goal: Protect University assets and investments

E.4.3.1(b) Priority: Medium

E.4.3.1(c) Timing: Perpetual

E.4.3.1(d) Accountability:
E.4.3.1(d)(i) Each individual
E.4.3.1(d)(ii) Deans, Chairs, Directors, Administrators

E.4.3.1(e) Current Status: Stage 1

E.5 Pandemics

E.5.1 Enterprise level

E.5.1.1 Develop a pandemic annex to the university emergency operations plan.

E.5.1.1(a) Target Goal: Protect life safety

E.5.1.1(b) Priority: High

E.5.1.1(c) Timing: Short term, Perpetual

E.5.1.1(d) Accountability:
E.5.1.1(d)(i) Sr Vice Presidents, Health Sciences/Academics
E.5.1.1(d)(ii) Associate Vice President, Facilities Management
E.5.1.1(d)(iii) Director, Environmental Health and Safety

E.5.1.1(e) Current Status: Stage 4

E.5.2 Department Level

E.5.2.1 Define which functions in the department are essential -- cross-train at least two individuals to perform each function. Create checklists to help with cross training.

E.5.2.1(a) Target Goal: Protect life safety; protect University assets and investments

E.5.2.1(b) Priority: High

E.5.2.1(c) Timing: Short term, Perpetual

E.5.2.1(d) Accountability:
- E.5.2.1(d)(i) Deans, Chairs, Directors
- E.5.2.1(d)(ii) Human Resources

E.5.2.1(e) Current Status: Stage 1

E.5.3 Individual Level

E.5.3.1 Read the Center for Disease Control handout on Pandemic Preparedness during 2009-2010.

E.5.3.1(a) Target Goal: Protect life safety; protect University assets and investments

E.5.3.1(b) Priority: High

E.5.3.1(c) Timing: Short term

E.5.3.1(d) Accountability:
- E.5.3.1(d)(i) Each individual
- E.5.3.1(d)(ii) Deans, Chairs, Directors

E.5.3.1(e) Current Status: Stage 1

E.6 Human Caused Events

E.6.1 Enterprise level

E.6.1.1 Develop an active-shooter annex to the university emergency operations plan.

E.6.1.1(a) Target Goal: Protect life safety; protect University assets and investments

E.6.1.1(b) Priority: High

E.6.1.1(c) Timing: Short term, Perpetual

E.6.1.1(d) Accountability:

E.6.1.1(d)(i) Vice President, Administration
E.6.1.1(d)(ii) Chief, University Police
E.6.1.1(d)(iii) Director, Environmental Health and Safety

E.6.1.1(e) Current Status: Stage 4

E.6.2 Department Level

E.6.2.1 Develop / review your department plan for reporting security concerns within the department.

E.6.2.1(a) Target Goal: Protect life safety; protect University assets and investments

E.6.2.1(b) Priority: High

E.6.2.1(c) Timing: Short-term, Perpetual

E.6.2.1(d) Accountability:

E.6.2.1(d)(i) Deans, Chairs, Directors

E.6.2.1(e) Current Status: Stage 1

E.6.3 Individual Level

E.6.3.1 Watch the University-produced Active Shooter video at least once during 2009-2010.

E.6.3.1(a) Target Goal: Protect life safety; protect University assets and investments

E.6.3.1(b) Priority: High

E.6.3.1(c) Timing: Short-term, Perpetual

E.6.3.1(d) Accountability:

E.6.3.1(d)(i) Each individual
E.6.3.1(d)(ii) Deans, Chairs, Directors, Administrators

E.6.3.1(e) Current Status: Stage 1

E.6.3.2 Participate in training related to emergency preparedness and response (e.g. Red Cross, U of U, faith-based community).

E.6.3.2(a) Target Goal: Protect life safety; protect University assets and investments

E.6.3.2(b) Priority: High

E.6.3.2(c) Timing: Short-term, Perpetual

E.6.3.2(d) Accountability:
E.6.3.2(d)(i) Each individual
E.6.3.2(d)(ii) Special Assistant for Emergency Management

E.6.3.2(e) Current Status: Stage 3

F. Conclusion

The University of Utah is a dominant presence in the State of Utah. In 2008, it reported generating a revenue stream in excess of $2.5 billion. Besides being one of the state's largest employers, the University provides a daily destination point for an estimated 40,000 to 50,000 individuals. It reports net assets of $2.7 billion, much of it nested in many of its 270+ buildings that are more than forty years old.

Because of its location, this institution is in a position that is directly analogous with other renowned universities. UC-Berkeley and Tulane University at New Orleans are prime examples. Each is located in a zone that has been recognized by experts as being in the target area for a significant disaster. Berkeley is in a prime earthquake and wildfire zone, while New Orleans is constantly under threat of hurricanes and flooding. Each has experienced significant damage or threat of real damage in the recent past. Other universities have survived similarly distressing events.

The University of Utah itself is recognized as being located right on top of an active earthquake zone that is predicted to shake loose at any time. It has been fortunate, so far—a significant event of this type has yet to strike. Although not the only type of disastrous event that could impact the University of Utah, it is widely recognized as being the most likely, with the most significant impact.

The process that was followed to arrive at the conclusions reached in this document involved participation from many sources: experts internal and external to the institution such as private sector specialists, local and state jurisdictions, law enforcement, hospitals and health departments, as well as internal history and institutional knowledge. It represents the best knowledge available at this time on the subjects relevant to this type of analysis.

This product offers recommendations that assign the responsibility for implementation of mitigation actions at three specific levels: individual or personal, departmental, and enterprise. Some of the recommendations might be considered low hanging fruit, while others will demand more substantial resources. The number of recommendations is not so large as to intimidate current and future decision makers at the University of Utah; however, several of them will require additional study and dedication.

The overall findings of this planning process and the resulting strategies suggest that the University, its stakeholders and governing bodies, cannot afford to digress from the path of pre-disaster mitigation planning that it so courageously embarked upon two decades ago. For the benefit of the institution, its diverse populations, and its many important programs and irreplaceable assets it is critical that disaster-resistant planning at the University of Utah does not devolve into just another initiative—it aspires to evolve into an integrated component to all future master planning activities and strategic decision making at the institution.

There is nothing the University of Utah can do to prevent an event such as an earthquake. It is not an option to replace all buildings on campus with new structures that are earthquake proof. We can, however, collectively modify the environment in which we work and learn to drastically decrease the likelihood of casualties and other unacceptable losses.

Such is the goal of this pre-disaster mitigation plan.

G. Tables, Maps and Figures

G.1 Tables

G.2 Maps

G.3 Figures

H. Hazard Maps

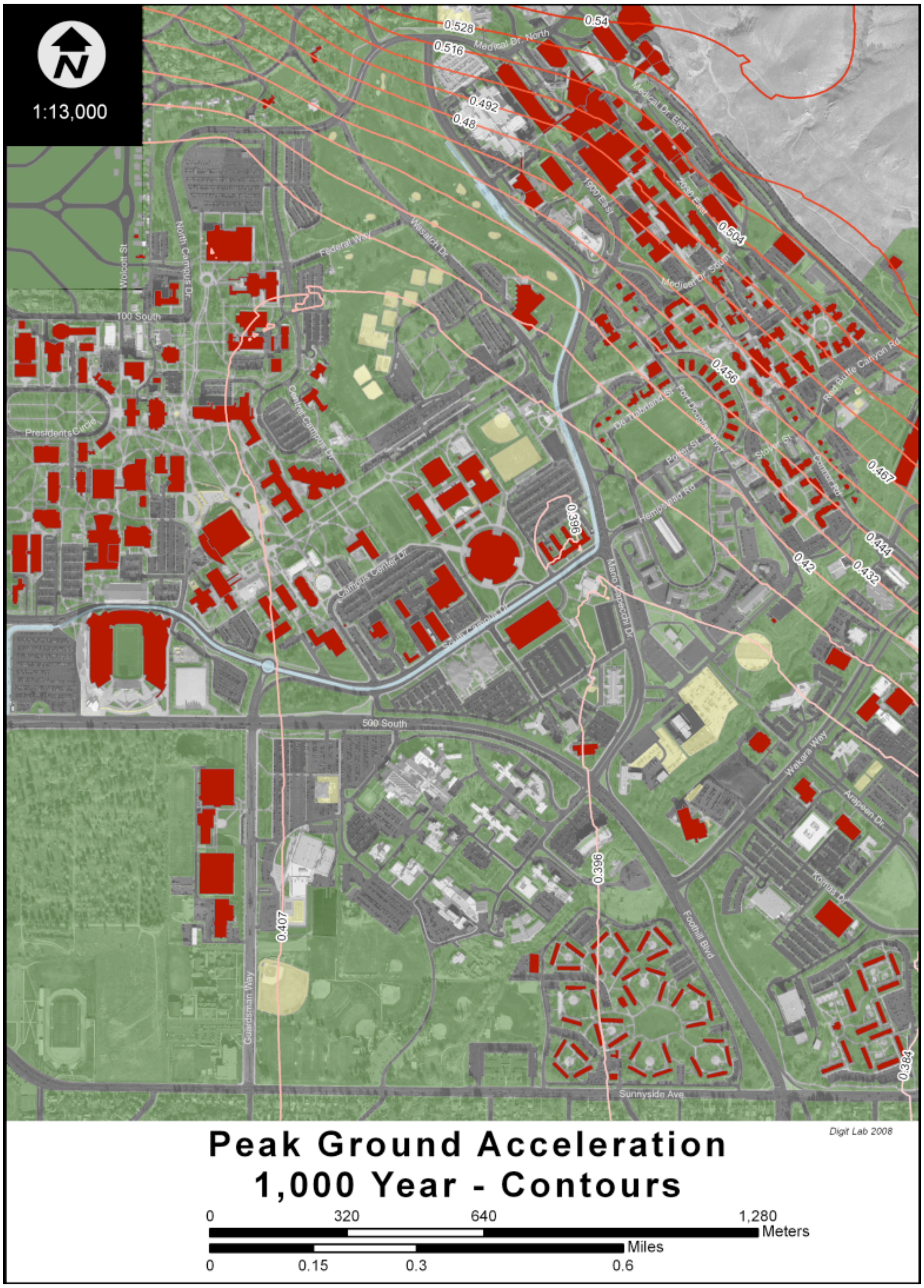
§201.6(c)(2)(i)(A)

§201.6(c)(2)(i)(B)

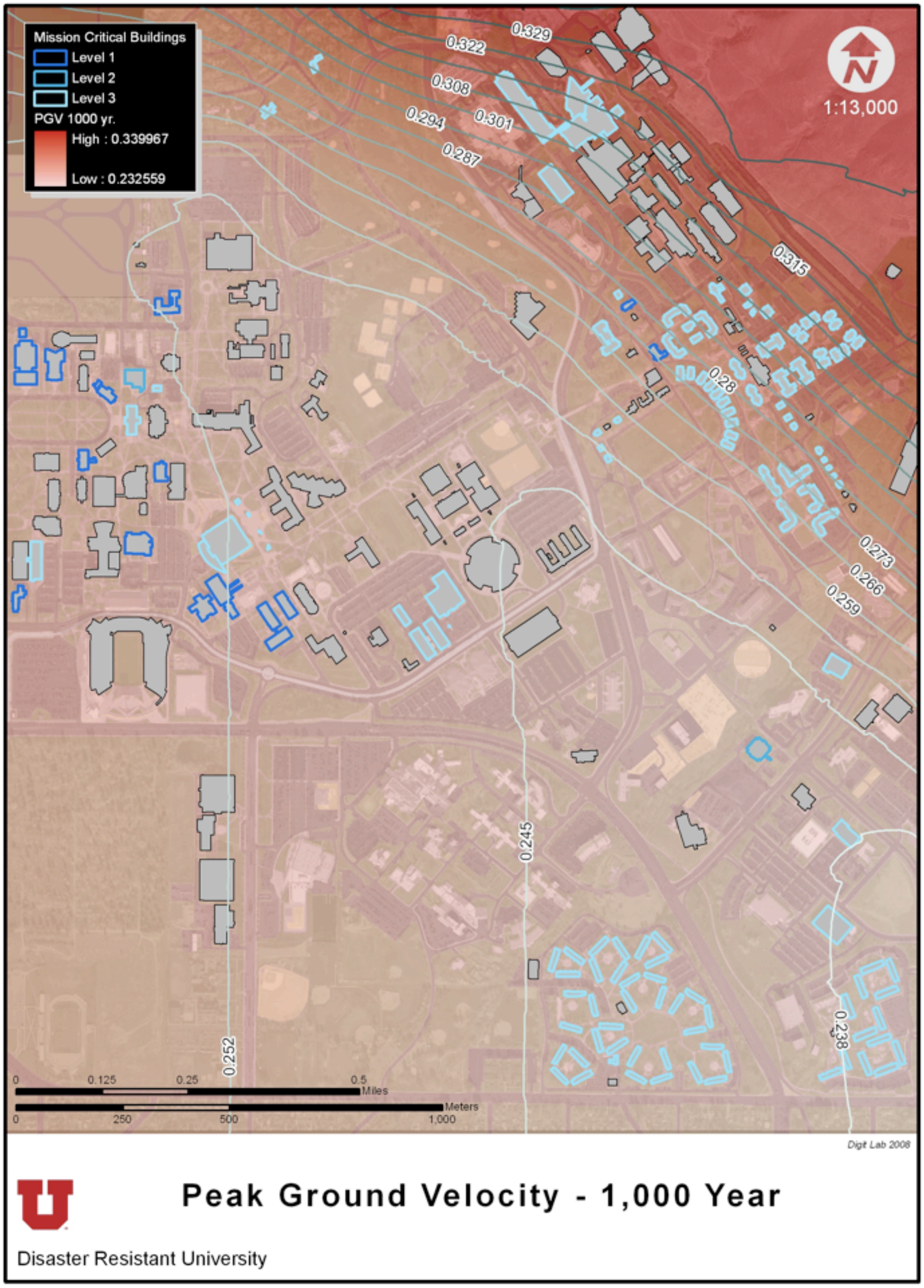
The following maps provide detailed views of how hazards intersect with buildings on campus. Ground motion maps show peak ground acceleration and peak ground velocity, indicating how much seismic force is expected across the campus. Flood maps detail a 100-year flood as well as dam inundation. Earthquake vulnerability maps highlight building damage state probabilities and casualties.

H.1 Earthquake Ground Motion

Map 6: Peak ground acceleration (1000 year return period)

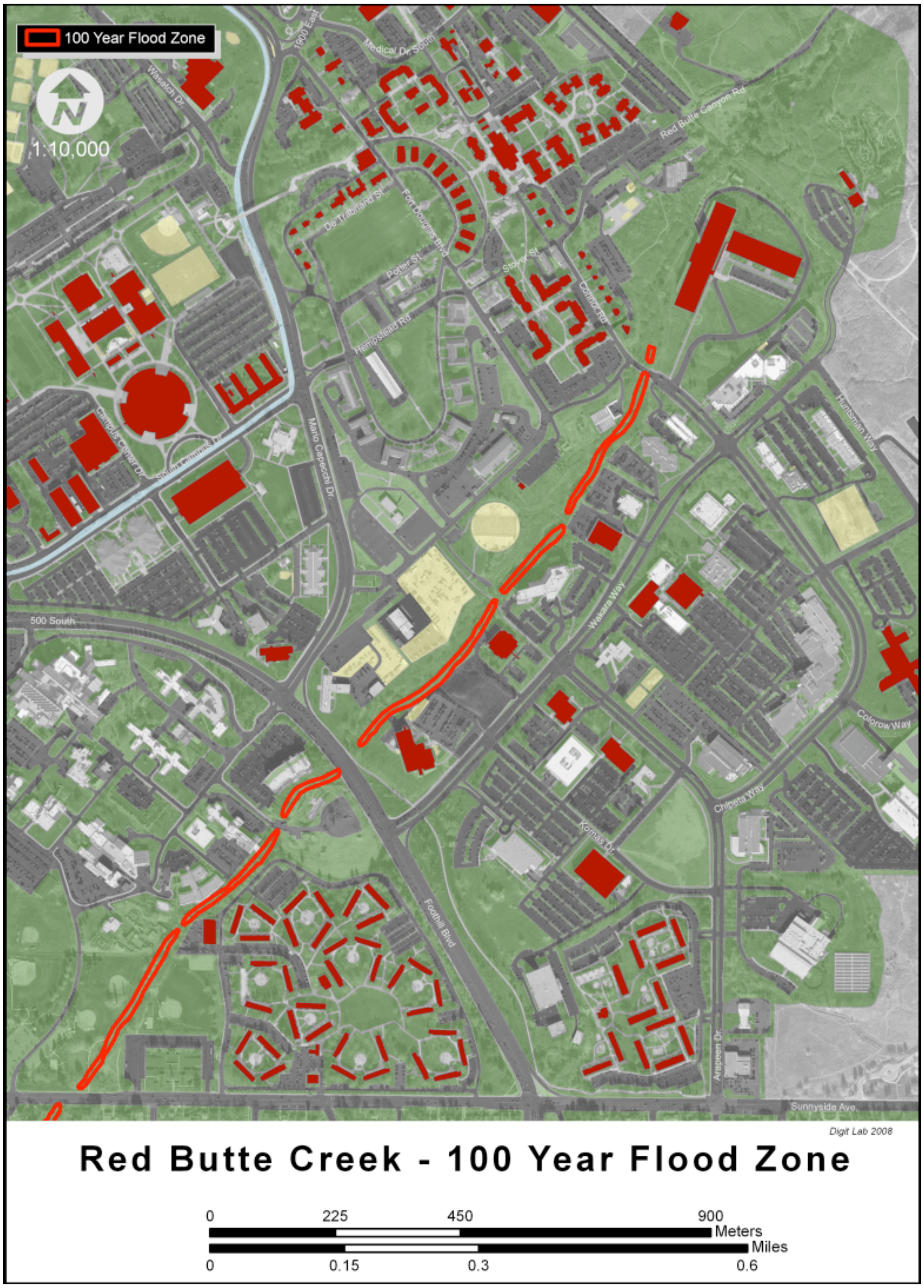


Map 7: Peak ground velocity (1000 year return period)

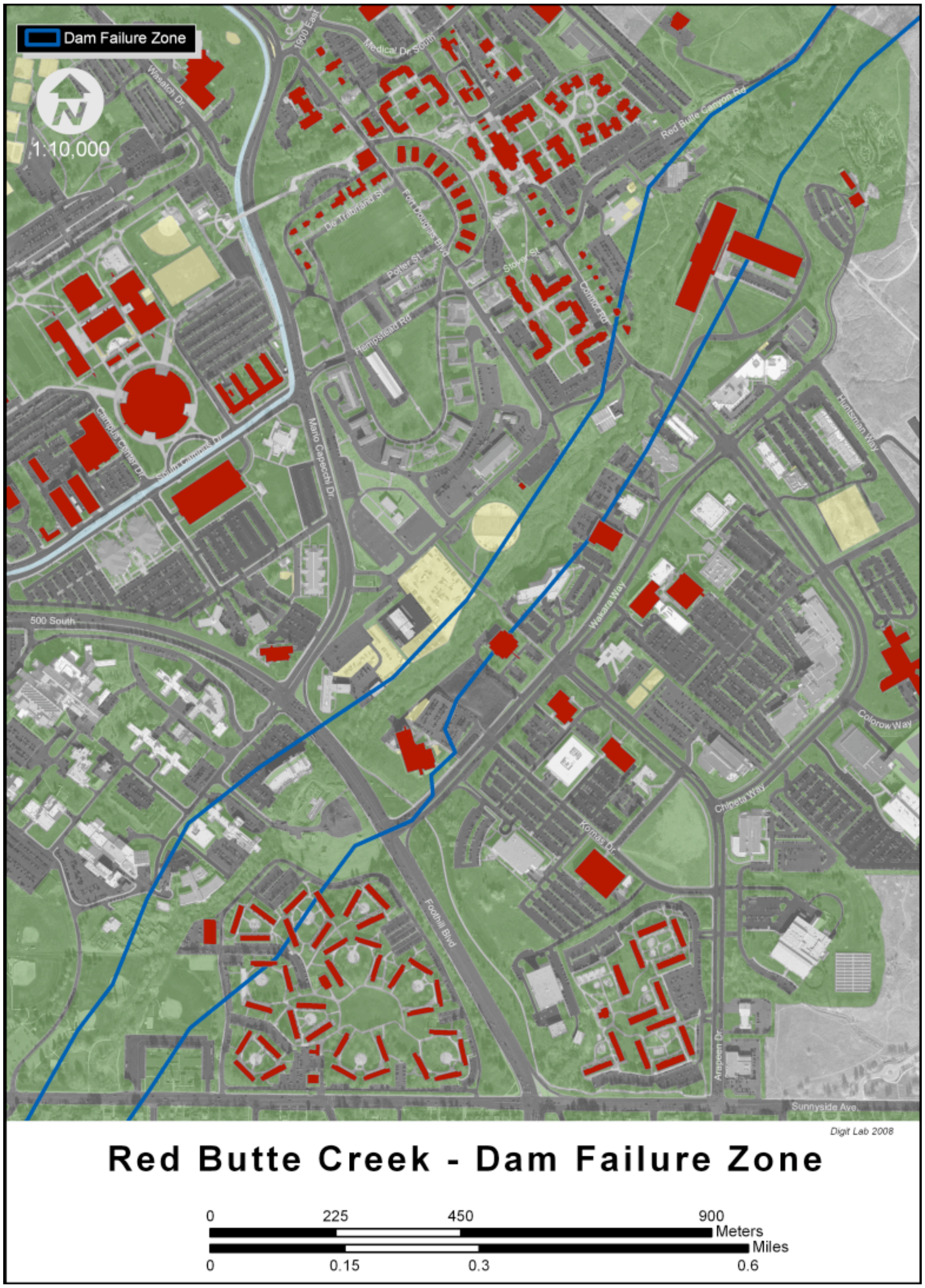


H.2 Flood Hazards

Map 8: 100-year flood zone

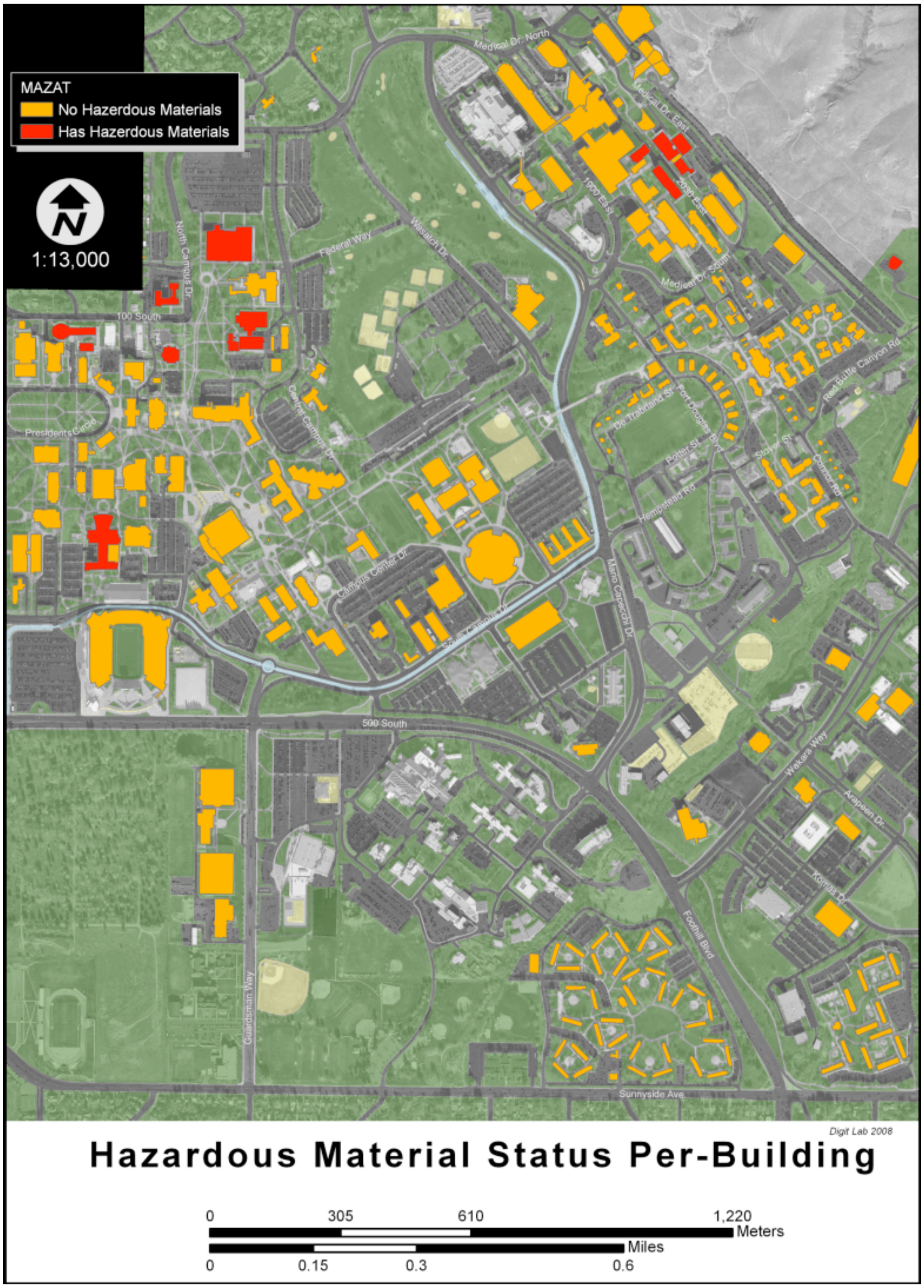


Map 9: Dam failure



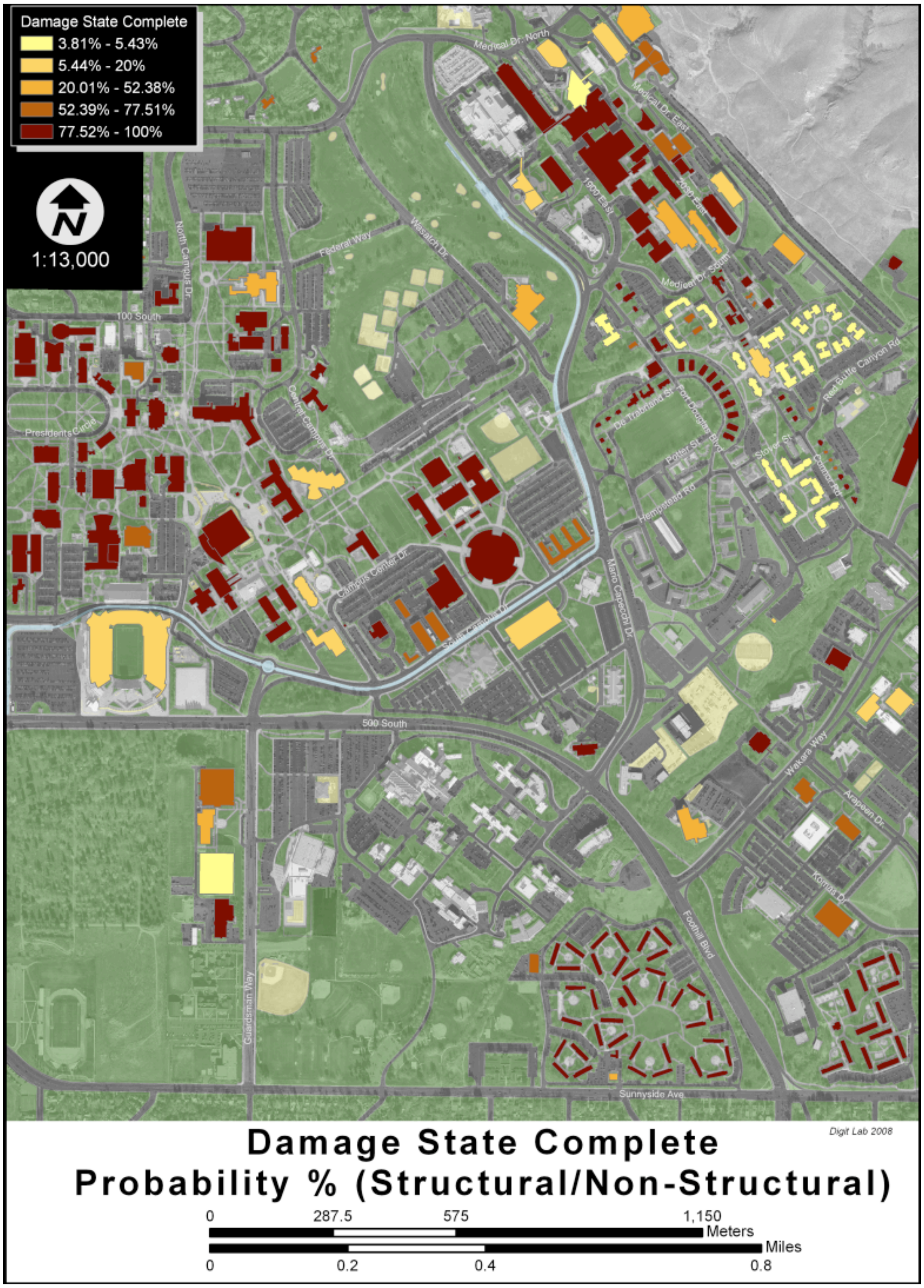
H.3 Hazardous Materials

Map 10: Hazardous materials



H.4 Building vulnerability due to earthquakes

Map 11: Buildings in complete damage state due to earthquake



H.5 Human vulnerability due to earthquake

Map 12: Day-time casualties (all levels) due to earthquake

Map 13: Day-time casualties requiring medical attention due to earthquake

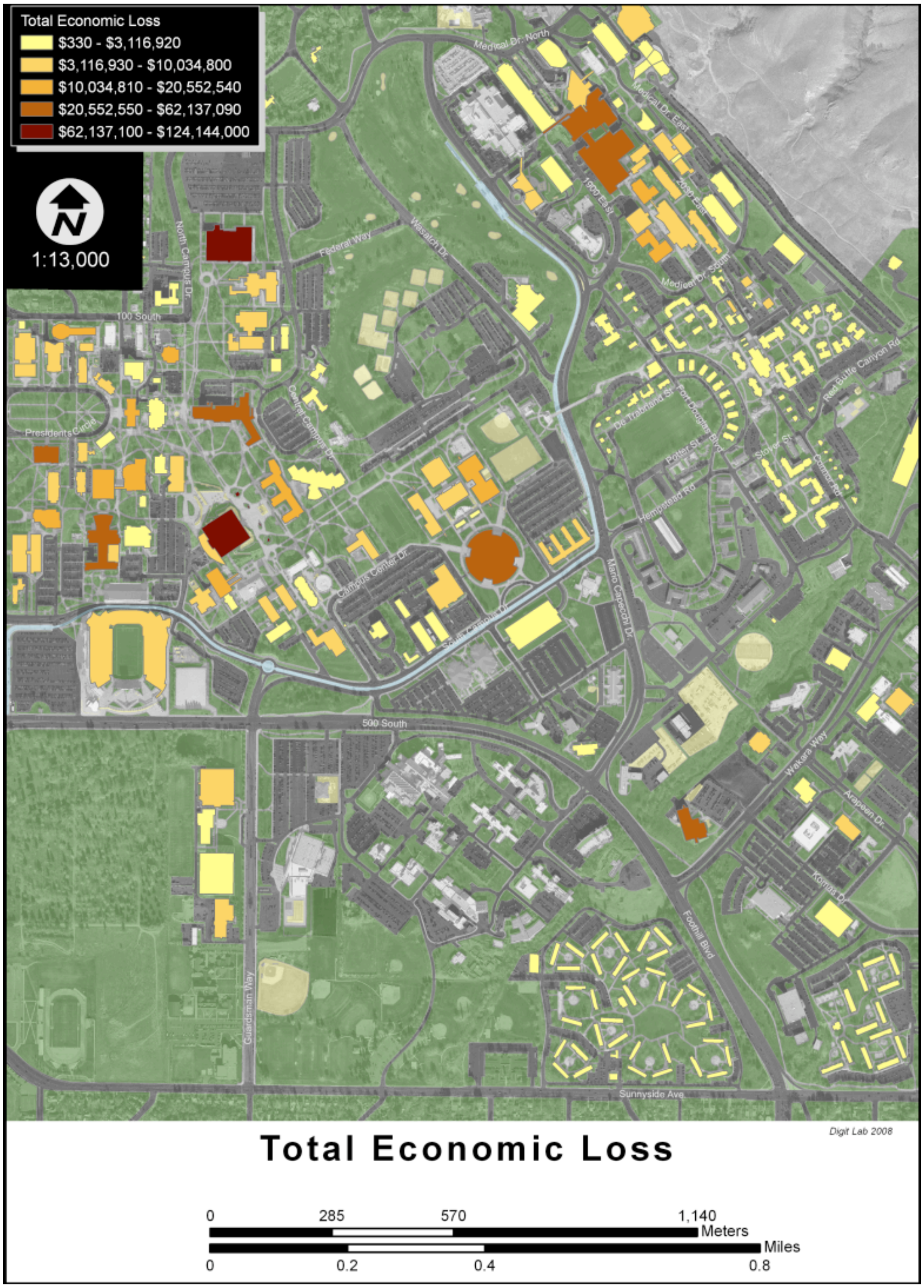
Map 14: Day-time casualties requiring hospitalization due to earthquake

Map 15: Day-time casualties with life threatening injury due to earthquake

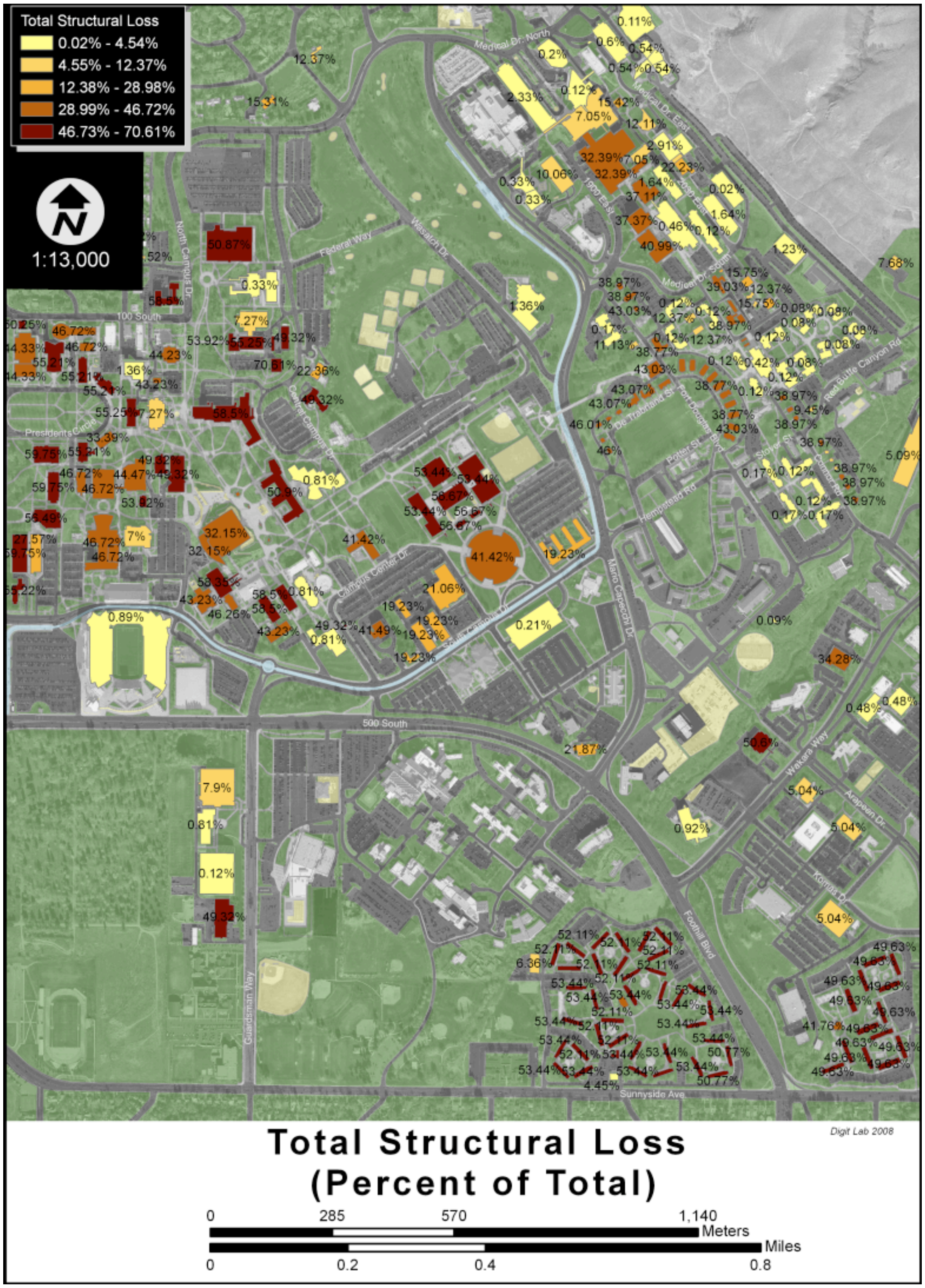
Map 16: Day-time fatalities due to earthquake

H.6 Economic loss due to earthquake

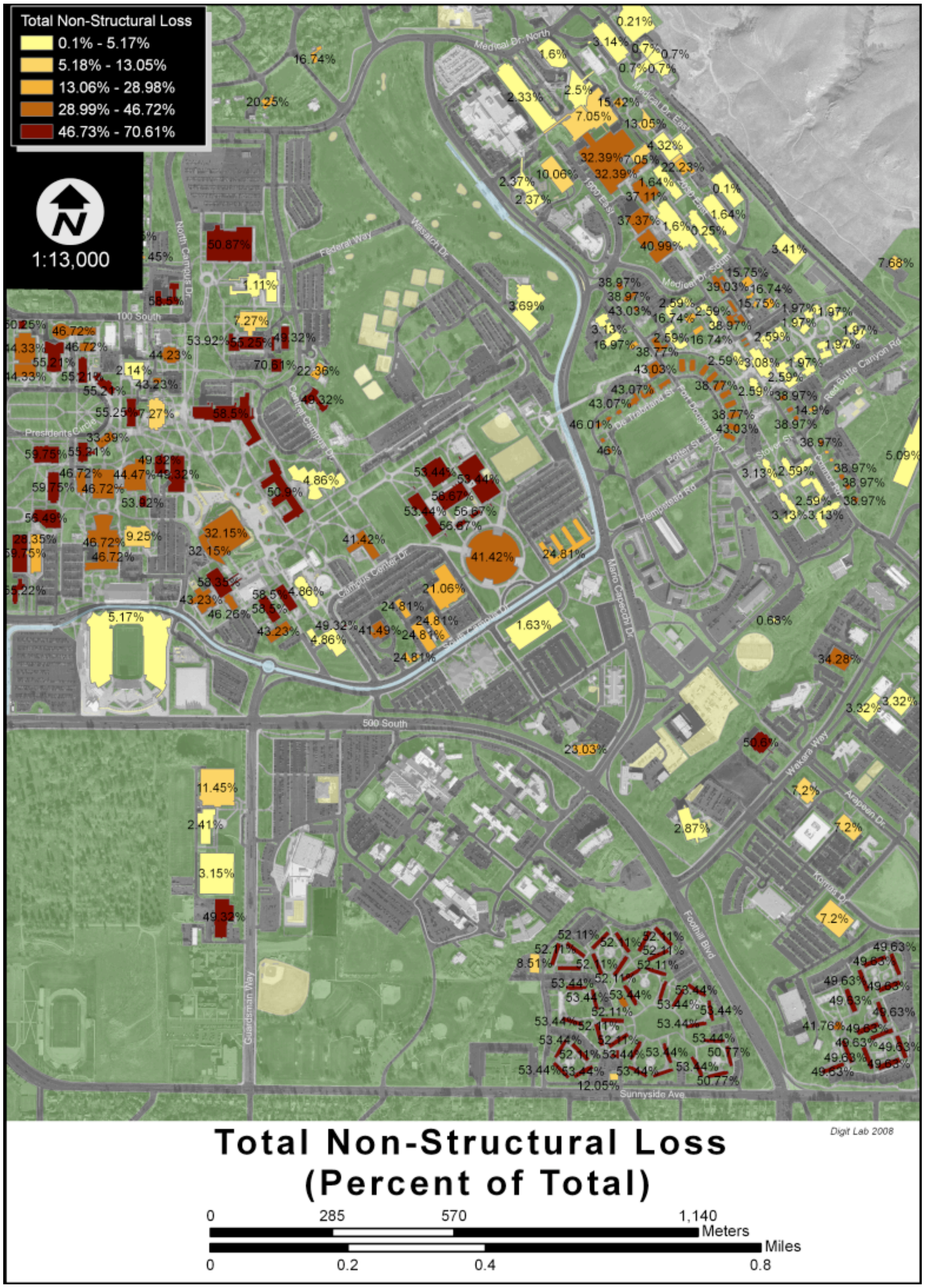
Map 17: Total economic loss for buildings due to earthquake



Map 18: Earthquake - total structural loss (as % of building value)



Map 19: Earthquake - total non-structural loss (as % of building value)



I. Appendices

I.1 Participants / Meeting Record

Table 19: Participants / Meeting record

DATE	NAME(S)	PURPOSE OF CONTACT
7/6/2006	Dr. David Pershing, Senior Vice President for Academic Affairs	Request for appointment of members to Advisory Committee
7/8/2006	Eric Browning, Planner, Facilities Planning	Clarify intent for performing seismic upgrades when programming building remodeling projects
7/8/2006	Dr. Tom Cova, Professor Geography Dept.	Request collaboration on planning activities, specifically referring to wildfires
8/22/2006	Tami Cleveland, Facilities Planning	Establish collaborative relationship with their office to obtain most current information on existing and proposed buildings
9/19/2006	Mike Perez, Assoc. VP Facilities Management; Randall Funk, Director Campus Design and Construction	Establish collaborative relationship with their staff to locate and obtain copies of all existing geotechnical reports
9/19/2006	Mike Halligan, University Fire Prevention Officer	Identify time line and opportunities for the development of an inventory of hazmat on campus
9/21/2006	Ryan Pietramali, currently Risk Analysis Branch Chief FEMA Region VIII; Tony Mendes, Branch Chief FEMA Region VIII; Doug Bausch, HAZUS Master FEMA Region VIII	Clarify expectations and deliverables associated with the awarding of the FEMA grant; identify opportunities to re-align components of the grant; firm up schedules (estimated meeting date shown)
10/1/2006	Ann Floor, Public Relations Specialist	Early planning for publishing briefs in FYI, the campus newsletter for staff and faculty
10/17/2006	Jeff West, Assistant Vice President for Finance	Initial contact with his office to gain support for our non-structural researchers to gain access to financial information, of which his staff are the stewards
10/30/2006	Sarah Nathe, Mary Comerio, Charlie Kitcher, et. al., UC Berkeley	Learn from their experiences as they might apply to the situation at the University of Utah
11/15/2006	Dr. Richard Brown, Dean of College of Engineering	Write and submit article on his behalf to be published in the College of Engineering Newsletter, describing the DRU Project and the College's involvement
11/17/2006	Ken Nye, Director, Facilities Business Services, Facilities Management	Arrange access to Facilities drawings for existing buildings by structural work team

11/21/2006	Dr. Paul Brinkman, Associate Vice President for Academic Affairs, Budget & Resource Planning	Obtain his support for the project and guidance for locating and obtaining much of the institutional data required for this analysis
12/15/2007	Joseph Taylor, Director, Administrative Computing Services plus several of his senior staff	To familiarize them with the DRU project and how it will potentially benefit them; To clarify our needs to data that PeopleSoft stores, and to identify the best processes to extract the data in a useful manner, plus associated time investments and costs
1/15/2007	Dr. Ray Gesteland, Vice President for Research	Obtain his support for the project; discuss ways to quantify research grants in specific buildings--economic and business impacts
1/15/2007	Coralie Alder, Director University Communications and Marketing	Line up opportunities for public meetings, publications, and newsletters exposing project to the public
1/31/2007	Dave Henry, Assoc. Director, Campus Utility Services	Acquaint him with this project; request clarifying data on pumphouses and substations
1/31/2007	Scott Folsom, Chief, University Police	Familiarize him with this project; discuss need to address shooters and violence in the workplace
2/2/2008	Dr. Paul Brinkman, Associate Vice President for Academic Affairs, Budget & Resource Planning	Follow-up meeting; spent significant time discussing the long-term prospects for the application of this strategy
2/5/2007	Dr. Jack Taylor, Director, Animal Resource Center	Acquaint him with this project; discuss impact of this planning on Animal Resources. Discussion on security and terrorism as affects his programs. Review steps already being taken by researchers to protect public from research animals.
2/6/2007	John Crofts and Judy Watanabe, State Emergency Planning	Collaborate on collecting known data pertaining to floods and wildfires
2/8/2007	Laura Snow, Special Assistant to the President; Patti Ross, Special Assistant to SVP David Pershing	Reviewed how their involvement in the Advisory Committee folds into their roles with the administration, and future communications
2/12/2007	Arnold Combe, Vice President for Administrative Services	Updates on the project; request support on obtaining information from various areas under his jurisdiction
2/13/2007	Thomas Loveridge, Associate Vice President of Human Resources	Acquaint him with the project; discuss impact of planning on HR, and vice versa
2/14/2007	Dr. Ray Gesteland, Vice President for Research; Dr. David Wolstenholme, Chair Biology Department	Discuss options for identifying research grants in each of Dr. W's buildings. He agreed to host a pilot study. Prepared and shared a letter of introduction for his use

3/8/2007	Coralie Alder, Director University Communications and Marketing; Remi Barron, Public Relations Specialist	Continue strategy discussion for public information; Identify process for establishing website for DRU
3/12/2007	Judy Watanabe, State Emergency Planning	Collect information regarding flood plains; familiarize her with DRU; invite input
3/15/2007	SVP David Pershing	Update on project status; initiate dialogue on the future of the strategy after this phase is complete
3/15/2007	Kevin Taylor, Director Office of Information Technology; David Huth, Director of Information Technology	Invited input into the Strategy from an IT perspective; also invited one or both to join us on our trip to Louisiana
4/15/2007	Adam Sobek, Director Digit Lab	Exploring opportunities for layering existing data such as utility maps and space assignment maps into DRU geospatial data
4/27/2007	Mike Perez, Assoc. VP Facilities Management	Solicit support in allowing our researchers to dig into FM's files for relevant building and soils data
4/30/2007	Randy VanDyke, Assistant VP Administrative Services	Solicit guidance in determining the best sources for budget and financial data needed by researchers
4/30/2007	Eric Browning, Planner, Facilities Planning	Establish foundation for permanent relationship between campus Master Plan and this Strategy
4/30/2007	U. S. Forest Service	Request information regarding the history of wildfires in this area. Also, asked for updates on mitigation actions recently implemented. Also, asked for clarification regarding management responsibilities for Red Butte Dam and reservoir
5/3/2007	Coralie Alder, Director University Communications and Marketing	Additional discussions regarding public meetings and printed outreach
5/3/2007	Brent Rhees, Assistant Area Manager, US Bureau of Reclamation, Provo Area Office	Attempting to track down history and ownership of Red Butte Dam and reservoir
5/7/2007	EHS Staff	Discussing options for DRU website design
5/8/2007	Paula Millington and Virlene Hirshi, Office of Information Technology	Discussing options for DRU website design, and future maintenance
5/17/2007	Deborah Alto, Project Manager and Architect, Campus Design and Construction	Reviewing intent of the DRU planning process and the relationship to planning efforts currently underway for the Heritage Preserve
5/18/2007	Jackson Carlton, Central Utah Water Conservancy District	Requesting collaboration on information pertaining to current status and condition of Red Butte Dam and reservoir. It is his responsibility to manage this facility.
5/22/2007	Tami Cleveland, Planner, Facilities Planning	Establish foundation for permanent relationship between campus Master Plan and this Strategy--continuing discussions

5/22/2007	Dr. Jack Brittain, VP for Venture Development and Dean of College of Business; Dr. James Wood, Director of Economic and Business Research	Attempting to identify process and individuals in the College of Business who could provide useful information regarding the economic impact of disasters on the University and its neighbors
5/22/2007	VP Arnold B. Combe	Learning about bond debt service at the University, and the potential impact on those debt payments of revenue streams are interrupted for any reason
5/23/2007	Bruce Gillars, Director, Space Management and Planning	Establishing long-term relationship between the DRU strategy and space assignments on campus
5/30/2007	Jerry Allred, Risk Manager for the University of Utah	Learning about insurance coverage on revenue streams if interrupted by earthquake: only on secondary damage (such as fires caused by earthquakes)
5/30/2007	Kent Beers, Program Manager, Utah State Division of Facilities Construction and Management	Determining possible funding streams for mitigation actions requiring capital funding
5/30/2007	Dr. Mark Spencer, Associate Commissioner of Higher Education, State of Utah	Acquaint him with the project; review possibility of other institutions in the USHE system to use similar planning process, or using this strategy as appropriate
6/5/2007	VP Arnold B. Combe	Updates on the project
6/26/2007	Deborah Alto, Project Manager and Architect, Campus Design and Construction	Follow-up on previous meeting regarding Heritage Preserve, wildfire and mudslide prevention
6/28/2007	Kim Cohee, Manager, UOC Physical Therapy	Discussion on emergency planning and mitigation planning at HSC
6/28/2007	Jeff Niermeyer, Director, SLC Public Utilities	Discovery of water system management plans for this side of the valley, with emphasis on hospitals
7/6/2007	Mike Perez, AVP Facilities Management	Discussions pertaining to future funding, estimating, and relationship between DRU and the master plan
7/10/2007	Basim Motiwala, Vice President, Associated Students of the University of Utah	Requesting active participation by a member of student government on the DRU Advisory Committee
8/2/2007	Kristin Phillips, Coordinator, Risk Management	Requesting information regarding history of claims resulting from natural disasters, or other over the last decade
8/2/2007	Jerry Allred, Risk Manager for the University of Utah	Clarifying the definition and application of the term "current replacement value" (CRV)
8/15/2007	Coralie Alder and Remi Barron, Public Relations Specialist; Ann Floor, Public Relations Specialist; Jason Smith, Editor Continuum Magazine	Further discussions on marketing strategies; administration's concerns about the manner and type of data that ultimately becomes public; set up schedule for DRU highlights in FYI (campus newsletter for staff)

8/16/2007	Douglas Christensen, Ombudsman, BYU	Reviewing opportunities for sharing information between the University of Utah and BYU
8/16/2007	Dr. James Wood, Director of Economic and Business Research	Follow-up on document he was going to prepare explaining issues and challenges with modeling economic losses after a disaster
8/21/2007	Jeff West, Assistant Vice President for Finance	Clarifying redistribution of research overhead collected from awarded grants
8/22/2007	B. A. Schwarz, Special Agent, FBI	Obtain information and literature regarding domestic terrorism, school shootings, etc.
8/29/2007	Community Forum Meeting	Provide information regarding the project to those in attendance, which included neighbors from the surrounding community as well as from on-campus
9/4/2007	Dr. Paul Brinkman, AVP for Academic Affairs	Discussing method used by the administration for assigning tuition and state dollars to specific buildings on campus.
9/7/2007	Jeff Sanchez, Emergency Coordinator at University Hospital	Soliciting more accurate data regarding occupancies in Health Sciences facilities. Also, making him more familiar with aspects of this planning process
9/13/2007	UAPPA Meeting at CEU; attended by senior facilities officers from most institutions of higher learning in Utah	Public presentation of the project, the process, the expected strategy, and anticipated results
9/22/2007	Gail Collins, Associate Partner, Skidmore, Owings & Merrill, LLP: consultants hired to prepare latest university master planning document	Identify specific details and process that could easily link the two projects together, both in this iteration as well as future updates; also provided to SOM selected actual findings regarding certain buildings
9/25/2007		Excursion by University of Utah team to LSU and UNO; Learn from both their pre-Katrina planning activities and post-Katrina lessons learned
10/2/2007	Mike Halligan, University Fire Prevention Officer	Discussions on wildfire risk along the eastern edge of campus
10/2/2007	Dr. David Dinter, Associate Professor, Geology and Geophysics	Questions about the degree of involvement by representatives of the University and his department, specifically
10/12/2007	Jennifer, reporter for the Utah Daily Chronicle	Interview for eventual publication in the student newspaper
10/16/2007	Salt Lake City Public Utilities, Jeff Niermeyer, Director and other staff; also Colleen Connelly, Don Thompson from University Health Sciences	Identify short-term and long-term plans in place at SLCPU that will impact emergency plans (mitigation and preparation) at the University and its hospitals; also obtain feedback from them regarding our planning efforts

11/19/2007	Kim Wirthlin, Vice President for Governmental Relations	Familiarize her with this project; discussions on potential funding strategies and limitations impacting implementation of mitigation actions
12/5/2007	Gail Collins, SOM	Follow-up meeting on relationship with campus master planning project; additional sharing of data
12/11/2007	John McNary, Director Campus Design and Construction	Request help in estimating the cost of certain potential mitigation actions
12/12/2007	Parry Brown, President Reaveley Engineering	Shared video files with us prepared to obtain state funding for rebuilding of Marriott Library
12/19/2007	Office of Sponsored Projects	Budget reconciliation discussions
12/24/2007	Amy Albo, Editor, Pulse Employee Newsletter at University Hospital	Collaborate on article to be published in Pulse describing DRU
1/4/2008	Mark Liddle, Manager, Manager UH Facilities & Engineering; Joseph Asay, Cost Control Estimator, UH Facilities & Engineering	Shared intent of the project with them; Invite their feedback; also, make arrangements with them in case we should need support in estimating cost of potential mitigation actions
1/10/2008	Tami Cleveland, Planner, Facilities Planning	Follow-up discussion regarding linkage between HMP and the Master Plan
1/16/2008	University Communications Council	Membership includes all individuals on campus having responsibility for communications and publications for individual departments. Purpose was to share details of the project with them and to solicit their feedback.
1/21/2008	Sarah George, Director Utah Museum of Natural History	Share aspects of the strategy with her, and how it could affect her if the Legislature does not fund the balance of the new building project
1/25/2008	Brad Bartholomew and Bob Carey, State Office for Emergency Planning/Homeland Security	Review progress of our project; review current status and determine appropriate future activities regarding potential mitigation actions, as they need to be listed in the Strategy
2/5/2008	Colleen Connelly and Jeff Sanchez, University Health Sciences Emergency Planning	Reviewing the HSC emergency plan, particularly as it pertains to mitigation and agree on how it should fold into the campus HMP.
2/29/2008	Prof. Wayne McCormack, College of Law; Norm Chambers, AVP Auxiliary Services	Discussions on mitigation and emergency planning as it affects the campus on a larger scale
3/13/2008	Dr. David Pershing, SVP, Academic Affairs	Quick review of process to be used, potentially, in presenting Strategy to Board of Trustees; agreed on need for subsequent meeting
3/17/2008	Alice Whitacre, Associate General Counsel	Establish process for legal review of Strategy before it goes to Trustees

3/25/2008	Jason Smith, Editor Continuum Magazine	Agreed on time frame for interview as well as possible publication date for an article on this project, to be released in Fall, 2008.
4/23/2008	Dr. David Pershing, Dr. McCormack, VP Arnold Combe, AVP Randy VanDyke, AVP Mike Perez, Director Marty Shaub, Pete van der Have	Discussion on process to be followed for bringing project before Trustees for that body's adoption of the DRU Strategy
11/14/2008	Jerry Allred, University Risk Management	Offered questions and suggestions regarding the document and its contents. Expressed comfort with the process as well as the project.
12/1/2008	Mike Olson, Reporter, Daily Utah Chronicle	Interview for purpose of publishing article emphasizing campus mitigation efforts, past present and future.
ADDITIONAL PARTICIPANTS, RESOURCES AND CONTACTS:		
	Cynthia Argyle	Research Assistant, Non-structural
	Barbara Nielson	Associate Director, Compliance Accounting and Reporting
	Brian Nielson	Associate Director, Plant Operations
	Camille Coons	Research Assistant, Non-structural
	Craig Bohn	Associate Director, Plant Operations
	Evelyn Garlington	Coordinator, Facilities, Space Management and Planning
	Jacob Huish	Surveyor Technician, Plant Operations
	Jesse Malan	Research Assistant, Structural
	Kari Astle	Former Planner, Facilities Management
	Krista Mitchell	Assistant Director, Oregon Natural Hazards Workshop
	Matthew Urick	Associate Director, Space Planning and Management
	Monica Fischli	Research Assistant, Non-structural
	Pat Tripeny	Associate Professor, College of Architecture and Planning
	Ray Wheeler	Associate Director, Space Planning and Management
	Ron A. Muncey	Principal System Analyst, Administrative Computing Services
	Ryan Smith	Assistant Professor, College of Architecture and Planning
	Steven Bartlett	Assistant Professor, Civil Engineering

I.2 Information Technology

I.2.1 Project Management

I.2.1.1 Basecamp Project Management Web Application

The distributed nature of the people working on the project caused the project management team to decide on the use of a project management system to keep track of tasks and schedules. Microsoft Project was initially used to accomplish this, but more time was spent managing Microsoft Project than was spent on mitigation planning activities. A decision was made to use the Basecamp project management system, a for-fee online task and schedule application provided by a provider known as 37signals.

Initial usage was somewhat hampered by getting to know and use a new system. As team-intensive activities took unfolded the Basecamp application (hosted at http://dru.projectpath.com) facilitated keeping everyone on track.

In later stages of the project team members attempted to use other features of Basecamp, including “Writeboards” – online document collaboration – with limited success due to lack of formatting features. As the project team shrank, once the data collection and hazard assessment portions were completed, the remaining team members found it convenient to communicate by regular email and document attachments. In the final stages of the project, use of Basecamp increased again because the final mitigation Strategy document became too large for email attachments. Basecamp accordingly became the repository for uploading Microsoft Word versions of the Strategy for other team members to download and review.

Overall the use of an online project management system, and especially because of Basecamp’s simple user interface, managing the mitigation planning process was made much easier.

I.2.2 Geospatial Information Systems

I.2.2.1 HAZUS-MH and InCast

I.2.2.1(a) Current Usage

HAZUS-MH (for *Hazards U.S. – Multi-Hazards*) is a natural hazards loss estimation software program distributed by the Federal Emergency Management Agency (FEMA). HAZUS can be ordered for free from FEMA Distribution. Its use can be rather restrictive since it requires the commercial ArcGIS platform from ESRI.

The DIGIT Lab, a geographical information systems (GIS) center at the University of Utah, was contracted to run the HAZUS program, primarily since the process involves a significant number of GIS layers: 1) the number, type and detailed survey of 270 buildings on campus, 2) soil characteristics across the campus based on the most recent soil cores from Campus Design and Construction at the University of Utah, 3) ground motion analyses representing how much and how fast the ground would move in an earthquake. The use of these layers required employing the Advanced Engineering Building Module (AEBM) to calculate losses per building.

HAZUS-MH is capable of different levels of analyses. Level 1 permits a user to run an analysis on a region without any additional input – HAZUS will use the regional and national datasets it is shipped with in order to produce results. Level 2 analyses use customized local inventory rather than the national data. A level 3 analysis included inventory improvement and use of the AEBM. Because of our ability to access qualified researchers from among university faculty, the results presented in this earthquake hazard assessment are based on a Level 3 analysis, with expert participation and input by an architect, a geotechnical engineer and a structural engineer.

The University's inventory and GIS layers are computed according to a sound scientific model found in the HAZUS-MH MR3 Technical Manual.

The product of a HAZUS "run" is a technical report describing casualties, damage state, and economic loss factors per building in the inventory. An aggregate report is also produced with the same parameters for all buildings in the inventory.

As the project's information inventory became more complete, and/or as the input methodology was adjusted, a subsequent run would produce a new AEBM report. The reports generated by the final HAZUS run include specific economic and casualty loss estimates for many buildings on campus. For this reason, and realizing that these are *estimates* from a *scientific model* and may not represent actual loss for a real earthquake scenario, the report is confidential.

I.2.2.1(b) Level 3 Analysis Issues

HAZUS-MH permits three types of loss estimation analyses. Level 1 is made possible by using the built-in hazards and generic national data sets provided with the software. Accuracy improves as users provide their own inventory to run Level 2 analysis.

Level 3 analyses include specialized GIS layers for ground motion, or the adjustment of built-in damage functions, in order to tune the loss estimation for a specific geography. The University of Utah chose to run a Level 3 analysis, but doing so increased the learning curve of understanding loss estimation.

I.2.2.1(b)(i) AEBM Profile Issues

An AEBM profile describes damage and loss function parameters and other building performance characteristics. Every building in the inventory must be linked to a profile, but a profile can be used for more than one building. At the beginning of the project we were counseled by state and federal mitigation experts to use fewer profiles – the one-to-many strategy. In order to facilitate managing profiles in the future, researchers assigned every building to one of 16 profiles originally developed. Considerable work was put into developing the profiles and assigning all buildings in our inventory to one of those profiles.

Midway through the project we found justifications to create additional profiles, based on unique characteristics of the many, diverse buildings in our inventory. As we investigated the matter further, a discussion with Charles Kircher (a renowned expert on loss estimation and one of the original contractors who helped develop the AEBM model) strongly recommended use of a one-to-one strategy where each individual building has its own profile. This approach will allow the adjustment of an individual building to "strengthen" it in the model, and re-run the analysis to measure the benefits of seismic mitigation. While it was not within our scope to provide this level of detail in the mitigation strategy, it is anticipated that actual mitigation projects to seismically retrofit buildings would require or could benefit from this kind of evaluation. Thus, we now have the dataset for our building inventory prepared for future mitigation work. This advantage came at the expense and time-delays of changing our AEBM profile strategy mid-project.

I.2.2.1(b)(ii) GIS Layers

Soil and ground motion data from our geotechnical engineering faculty expert was delivered to the DIGIT Lab that required extensive work to conver the data for the analysis.

I.2.2.1(b)(iii) HAZUS Versions

We initially used HAZUS-MH MR2 in early phases of the project, but soon uncovered some anomalies in running a large and detailed inventory with our customized hazard layers. Some runs gave unexpectedly large numbers for values that should have been small. These were identified as defects in the software and not our input data. Subsequently we upgraded to HAZUS-MH MR3, which fixed the problem. The upgrade required effort by the DIGIT Lab to recreate our study region, scenario earthquake, and re-apply our customized layers.

I.2.2.1(b)(iv) InCast

InCast is an inventory collection and survey tool that is distributed with HAZUS to aid in building inventory data collection. It is a simple tool that permits the creation, updating and deletion of buildings and their structural and non-structural characteristics. There are 130 fields that InCast can collect per building, covering the full range of hazards HAZUS is able to analyze (earthquake, flood, and hurricane).

While we only concerned ourselves with the fields pertaining to earthquake and flood, there were still many data collection points to support a Level 3 analysis. The single-user desktop InCast system became a bottleneck for our geographically dispersed, multi-user data collection team. It became clear to the project team that an alternate method of maintaining inventory data would be very beneficial to both this project and future users. These alternate methods are described in section F.1.2 Data Management.

I.2.2.2 DIGIT Lab information technology

The DIGIT Lab houses the spatial data repository for campus GIS applications. It was a natural fit to contract with DIGIT to provide HAZUS expertise because much of our building inventory is already modeled spatially in their system (coordinates, building shapes, area, usages, etc.). We were able to leverage the knowledge of campus GIS to solve intricate issues with building inventory. For instance, a number of our buildings are composite structures. That is, over the years they have had additions built onto the original structures. In some cases the additions are completely distinct AEBM building profiles despite appearing as "one" building on the campus map. The DIGIT Lab's GIS experts were able to accommodate these anomalies into the HAZUS loss estimation.

Another advantage of contracting with the DIGIT Lab is the recognition that many sister organizations also keep their GIS data and applications housed on their servers and in their data center. Facilities, Space Planning, and the Campus Map all share basic campus GIS data. The Disaster Resistant University project dataset now also resides at DIGIT, identifying the Lab's role as enablers of data analysis whenever DRU data stewards need to access more risk assessment information as the University's planners head into mitigation projects in future years.

I.2.3 Third-party Open Source Components

A significant effort has been made to leverage third-party open-source components to build new, custom software for hazard mitigation analysis. The following descriptions serve to highlight best-of-breed tools in server, database, and user-interface components that were freely available to custom software development as part of the Disaster Resistant University project.

I.2.3.1 Server Components: Apache Geronimo and Apache Tomcat

Apache Geronimo is an open-source platform from the Apache Foundation that implements the entire Java Enterprise stack, which includes: a Servlet container, an EJB container, messaging provider (JMS) and Java Connector (JCA) container. Geronimo includes the Tomcat Servlet container, which acts as the application server for the InCast Web application.

An early advantage of using Geronimo was provided by its database pooling and connector functionality. Subsequent improvements in the data layer system made this unnecessary, but Geronimo still offers convenient application loading, re-loading, stopping and starting.

I.2.3.2 Database Components: Hibernate and MySQL

I.2.3.2(a)(i) Hibernate is an object-relational mapping system (ORM) that simplifies the synchronization of an application's objects and their representation in a relational database. Hibernate allows a software developer to abstract how the applications "talks" to the database layer, allowing different databases to be used, depending on information technology support. For instance, a software prototype needing a database may use the most convenient database package available for the developer. However, deployment requirements may require a completely different database package. Hibernate allows the software developer to "swap out" one flavor of database for another with minimal impact on the application logic which is accomplished by "mapping" objects that need to be stored to specific tables in specific databases via a robust configuration file. Hibernate is provided by JBoss.

I.2.3.2(a)(ii) MySQL is the world's most popular open source general-purpose relational database. MySQL has an active development and user community. Most web application tutorials on the internet that require database connectivity contain detailed instructions on how to set up and use a MySQL database. MySQL was purchased by Sun Microsystems but maintains a free and open-source version.

I.2.3.3 Logic Components: JBoss Rules

JBoss Rules is a Java-based implementation of the Rete rule engine algorithm. The Rete algorithm is a pattern-matching algorithm for implementing production rule systems. Rule engines allow a developer to extract application logic from the actual application code and express them in pseudo-language syntax. This decoupling of application logic from the "guts" of the code has two advantages: 1) very complex decisions that would normally be expressed with a deeply nested if/then/else structures can instead be expressed as a group of simple atomic or individual rules which the Rete algorithm can build into a decision tree at run-time, and 2) maintenance of business or domain rules can be achieved without introducing defects into large nested logic structures and be accomplished by domain experts rather than only software developers.

I.2.3.4 User-Interface Components: Google Web Toolkit

Google Web Toolkit (GWT) is an open-source Java-based software development framework that makes writing rich AJAX internet applications (like Google Maps or Gmail) easy for taking care of browser and platform inconsistencies. GWT permits a developer to write a front-end user-interface in the Java programming language which GWT then cross-compiles into optimized JavaScript that automatically works across all major browsers. Development in Java gives the programmer access to all of the advantages of using familiar integrated development environments (IDEs), including unit testing and debugging. GWT takes the pain out of developing web-based, JavaScript applications while at the same time providing built-in tools and widgets to create rich, desktop-like applications that run in the browser.

I.2.4 InCast Web Edition

I.2.4.1 Rationale for Recreating InCast desktop software

In the setting at University of Utah, a diverse group of collaborators was engaged in supplying building-specific data for a campus hazard and risk analysis. Three co-principal investigators from the academic disciplines of architecture, structural, and geotechnical engineering – along with a number of graduate students in each field – contributed to collecting one hundred and thirty data points for over two hundred and seventy buildings. Although the initial structural information was collected with the standard desktop InCast software, it became troublesome early in the project to synchronize updates to the data set as new information emerged. An improvised methodology to share a master spreadsheet seemed beneficial, but subsequent attempts at quality assurance were impeded by numerous and differing versions of the data source. Under these circumstances, it became obvious to the project management team that a new mechanism to maintain this crucial data set was needed.

I.2.4.2 Development

InCast Web development was started in August 2007. By August 2008, a prototype was in a sufficiently good state to demonstrate at the National HAZUS User's Conference, where it was met with good response. While established as a multi-user development project, only one developer has actively participated in design, coding, and maintenance of InCast Web.

Standard software development practices were followed in producing InCast Web Edition, including: design, unit testing, issues tracking and managing features and defects. In the year of development (Aug 2007 – Aug 2008) approximately 100 hours were spent on feature description and design, 400 hours were spent on coding and integrating third-party components, and another 100 hours on managing defects.

I.2.4.3 Project Repository

InCast Web is currently available as an open source project hosted at the Google Code software repository (http://incast.googlecode.com). InCast Web will be delivered to FEMA in September 2009 and it is anticipated it will be available for use by others shortly thereafter.

I.3 Data Collection Methodologies

I.3.1 Structural

I.3.1.1 Structural Assessment Report

I.3.1.1(a) Processes and Procedures Used in Structural Seismic Hazard Assessment Report of University of Utah Campus Buildings

The following report was written by Jesse Malan, then a graduate student in the Department of Civil Engineering, under the direction of Larry Reaveley (co-principal investigator) and submitted to the DRU management team on 09 May 2007. A discussion concerning portions of the methodology that changed after Jesse's work was completed follows his report.

Note: Figures have been re-numbered to correlate with the main document.

Processes & Procedures Used in Structural Seismic Hazard Assessment Report of University of Utah Campus Buildings

Summary

This report is a documentation of processes and procedures used in developing the structural assessment of University of Utah campus buildings for potential earthquake vulnerability and mitigation. It was created in a somewhat chronological order of events. This report reflects what methods, tasks, procedures and the like worked best for carrying out the duties of the structural team only. It will also point out what was optimized, what produced no results, poor results and dead ends.

Research

As the time came for the technical groups to become involved in the Disaster Resistant University (DRU) project, exactly how to approach the structural aspects of the study was not known. As a result, much time was spent in studying materials that seemed related to the project.

It was believed that this project might use an upgrade to the RVS procedure. The first documents studied were the FEMA 154 and 155 publications of Rapid Visual Screening (RVS) of Buildings for Potential Seismic Hazards. For someone who is unfamiliar with building types, data collection, potential structural problems, benchmark years, and damage scores, this is very useful. These documents explain the screening process in simplistic terms so that a broad audience can understand potential seismic hazards. If an RVS study has been done previous to a new disaster study, it would very advantageous to acquire such documents as they contain other building assessment information that can help in the new assessment.

Early on in the project, it was discovered that a program called HAZUS-MH MR2 would be available for use in the study. Since not much was known concerning this particular program, the program manuals were reviewed to see how the program would apply to the project. It was determined that the program would be extremely useful in determining the effects of an earthquake disaster on campus buildings. Douglas Bausch from FEMA, who had an influential role in the development of the HAZUS software, suggested that only the Advanced Engineering Building Module (AEBM) of HAZUS should be used for this project. The program manual entitled "ADVANCED ENGINEERING BUILDING MODULE TECHNICAL and USER'S MANUAL" gave very useful information. The manual entitled "Technical Manual", and especially chapters 3 and 5 were also studied with the expectation that adjustments of fragility curves and other damage function curves might be a part of this project. Although the information learned was useful, it was not needed as the level of refinement was deemed to be not necessary and may not be achievable.

Other documents obtained and studied that were believed to be useful and may or may not have been include: FEMA 395-400, FEMA 356, FEMA 310, Evaluation of and Improvement for the FEMA 154 Rapid Visual Screening Method by Wang and Goettel Feb 2006, Case History on the Oregon Go Bond Task Force: Promoting Earthquake Safety in Public Schools and Emergency Facilities by Wang and Burns Jan 2006, FEMA 443, FEMA Response and Recovery Division Online Hazard Mitigation Handbook Series (http://www.conservationtech.com/FEMA-

WEB/FEMA-master-web/INDEX.htm), First-Level Pre-earthquake Assessment of Buildings Using Fuzzy Logic by Demartinos and Dritsos, Probabilistic Response Assessment for Building-Specific Loss Estimation, Fault Line Forum Volume 15 Number 2 1999,

Buildings Included

Early on in the project, I obtained a list of campus buildings from the project manager. This became the starting point for all data collection. Frequent checks with project management were made to make sure I had included the necessary buildings for the project. At one point, the management created a list of buildings to be studied based on a priority created by them. This was critical in knowing exactly what buildings needed to be included in the project and what didn't.

It is crucial to the project to find a professional structural engineer, or collective group of professional structural engineers, from the professional community who can provide expert key advice as to the familiarity of local building stock and solid knowledge of benchmark years of seismic building codes. For this project, and in a rare situation, Lawrence D. Reaveley was able to fill this role as a prominent local expert of the building stock and especially seismic building codes for the region. This list was reviewed with Reaveley, who was able to make some comments to the prioritized building list. Management wanted to use a "representative" building to capture the effects of buildings that are extremely similar in construction and design. Reaveley brought up the point that in order to get the total amounts of damage in terms of dollars and casualties, it is necessary to put each individual building into the modeling software as the total damage is directly tied to the number of buildings included. The prioritized building list was expanded to include all of the so called "representative" buildings. Also, Reaveley was able to request that some buildings be added to the list due to his knowledge of vulnerable buildings on the campus.

Not all of the buildings on the priority list were included in the study. Management labeled these buildings as "Low Priority". The buildings on the list labeled with a low priority were included in the data gathering process but were not used in the modeling software. They would be included in the software as management deemed it necessary to look at them and the model would be run again.

Building List Creation

With the building information obtained as described above, the master list began to take shape. The following shows the required fields needed by the program HAZUS-MH MR2 to give the desired output:

Name	Daytime Occupancy	Business Income	Profile Name
Address	Nighttime Occupancy	Wages Paid	Seismic Design Level
City	Building Area	Relocation	Building Classification
State	Building Value	Rental Cost	Occupancy Class
Zip Code	Contents Value	Ratio of Building Owner	
Latitude	Business Inventory	Occupied	
Longitude			

The following shows the fields of information collected that are needed for the project, or needed to define inputs to the HAZUS program:

ID Number	Comments	Stories	Construction Date

The following table shows fields of information that were collected but had no direct program use. These fields can be beneficial as a means of assessing buildings for earthquake vulnerability and in other subjective ways. They could also be useful if they are readily available in an electronic format for future reference. The fields underlined indicate that they came from the 1989 and 2002 RVS procedures:

Designer Name	Basic Score	Short Columns	Falling Hazard
Basement	High Rise	Post Benchmark Year	Seismic Rating
Condition	Poor Condition	Soil Profile SL1 (no modification factor	Detail Evaluation Required
1st Remodel Date	Vertical Irregularity	Soil Profile SL2	Seismic Upgrade
2nd Remodel Date	Soft Story	Soil Profile SL3	Foundation Type
Occupancy Type	Torsion	Soil Profile SL3 + 8 to 20 stories	
No. Persons	Plan Irregularity		
1989 RVS Building Type	Pounding	Final Score	
	Large Heavy Cladding		

At the commencement of the project, it was believed that new fields could be added to the software program as desired. Much time was spent researching and deciding on new fields to add to no avail. HAZUS has no apparent way of incorporating new user defined fields, but much of this information was used to assess the overall seismic resistance of the individual buildings.

Building Photographs

As part of the information gathering process, photos were taken of each building to be included in the disaster study. A digital camera was used for ease of electronic file transfer and number of photos. A minimum of one photo was taken of each building, as long as one side of a building was representative of the other sides. The most difficult photos to obtain were those of locked underground structures such as pump houses, pressure stations, and reservoirs. Contact with the campus's head plumber can get you access to these places. It can also be advantageous to get some photos of the interior of a building to verify framing systems and lateral resisting systems. Make sure you let the right people, or security, know your role and exactly what you will be doing to minimize clearance and security issues.

The largest benefit of building photos to the structural team of the study was that it could be an aid in the determination of building types in council with a professional structural engineer. It also aided in determining the age of a building as to the construction year with engineering judgment. From the photos, the number of stories could also be easily attained.

The non-structural team of the project greatly appreciated the photos as they helped immensely in the discovering of various falling hazards and other useful architectural information.

For both teams, these photos eliminated the need for repeated visits to the various campus buildings to verify details and other gathered information.

The photos were burned onto (2) CD's and photos organized into folders according to the University's building numbering convention for easy access and data retrieval. Copies were given to both the structural and non-structural teams as well as project management.

A complete collection of campus building photos such as the one in this project can be extremely valuable to many university divisions and departments.

Study Area Map

Another useful item in data gathering is a comprehensive map of the campus and building locations. Having a good campus map available greatly aided in the identification of the different buildings. The usefulness and versatility of the map cannot be overstated.

Working Database

All project data was collected onto an electronic file. The program used was Microsoft Excel. Creation of tables is very fast and easy with this program. For optimized performance, it is recommended to use Microsoft Access or another similar program. The reason for this recommendation is that retrieval of certain types of information can be more difficult with a simple spreadsheet. For example, if a field is created with a simple true or false statement as to whether a photo has been taken for a building, a query can be performed to show the remaining buildings needing to be photographed. This query can be pulled each time one is to go out to take photos to aid in being more efficient. Another example would be to find out which buildings have not been assigned a building type. This list can then be printed and along with the photos taken previously, a professional structural engineer can review the information to determine or make a judgment as to the building type. There are a number of reasons to make a query of any needed information and hence a good data basing software is preferred.

Data Gathering

This is probably the most critical portion of the project. Good data is essential to obtaining meaningful output.

Sources

Obtaining the required information is not too difficult as long as you know where to look. The first place I went was the University's website. From there I could navigate to Facilities Management where a list of all campus buildings could be found with some needed info such as addresses and building square footage. An access code or login information may be required by some schools and universities.

The next source of information was the project management. From the management position they hold, they have access to much needed information or can at least direct you to someone who can give you the information you are requesting. For example, to get all the longitude and latitude coordinates of campus buildings, I was directed to contact an individual in the Department of Geography DIGIT Lab. He was able to send me a file containing all the building coordinates.

For missing latitude and longitude values from the Geography Department, I resorted to using the earth mapping internet based software Google Earth to locate the buildings and obtain the coordinates I needed.

Once I had exhausted my key contacts given to me from management, it was up to me to find the remaining info (i.e. missing records or data) that I needed. Very helpful in my endeavors was contact with a structural design professional in the area. He was very familiar with the buildings and could give much needed data. Also, he had access to and contacts in the Structural Engineers Association of Utah (SEAU). He was able to send an email, with an attached list of buildings that still needed some data found, requesting information from those professional engineers who designed those buildings. This proved to be very effective.

At this point, there was still some information to be gathered. The last 80-90% of the total data was the most difficult to gather. I made contact with Campus Design and Construction and talked to the Construction Documents & Photography Manager. She had access to nearly all of the campus's building drawings and documents. She granted me access to the drawing vault where I was able to search through the drawings to find the buildings I still had questions with. Many sheets were extremely old and had to be handled with great care. As a preparation to searching through the drawing vault, I created a data gathering worksheet to facilitate and speed up the process. This worksheet can be seen as attached in Appendix A. Not all fields were used in gathering data. I suggest that this worksheet, or a similar one, be used in gathering this information.

It should be noted that throughout this process of gathering data, comments and notes about each building should be taken and recorded although they are not directly used by the evaluating software HAZUS-MH MR2. These notes can be very valuable for future reference or for example, a seismic rehabilitation analysis.

Field Descriptions

The following is a description of all fields required for data gathering along with any specific formats and how that information was obtained and any other useful information.

ID Number

This field designation is actually not necessary by HAZUS but is very useful for reference. This number was the campus's assigned building number. It made for quick and easy lookup. It is also a unique field (each building has a separate and distinct number) so it can be referenced to from Microsoft Access or any other database software. HAZUS will truncate the address after 40 characters. Since this field does not exist in the HAZUS atmosphere, it can be imported under the name of "Comments".

Building Name

HAZUS will truncate the name after 40 characters. Thus it is a good idea to use a shorter name for the building.

Address

HAZUS will truncate the address after 40 characters.

City

HAZUS will truncate the city name after 40 characters.

State

HAZUS will truncate the state name after 2 characters.

Zip Code

HAZUS will truncate the zip code after 10 characters.

Latitude

This value should be in decimal form. HAZUS will truncate the value after 19 characters. This field is mandatory to run the AEBM of HAZUS. Every building must have a unique set of coordinates.

Longitude

This value should be in decimal form. HAZUS will truncate the value after 19 characters. This field is mandatory to run the AEBM of HAZUS. Every building must have a unique set of coordinates.

Daytime Occupancy

As part of the project, I was not required to obtain data for this field.

Nighttime Occupancy

As part of the project, I was not required to obtain data for this field.

Building Area

Gross square footage is what should be used. When that information was not available, I used either an engineer's estimate or the given net square footage. As an important note, whenever a building had more than one type of lateral force resisting system, the weakest building type was chosen to represent the entire building. This was preferred over the other method discussed which was to split the record according to the square footage of each lateral force resisting system.

Building Value

Actual value is to be determined by any reasonable estimation means. What this means is that HAZUS does not specifically state whether you should take the market value of the building or the value to the University according to its function or historical significance, etc. Money amounts are entered in the units of thousands of dollars. As part of the project, I was not required to obtain data for this field although this is a critical value since it has direct impact on the potential for damage quantification.

Contents Value

This field represents the value of the contents of the building. Money amounts are entered in the units of thousands of dollars. As part of the project, I was not required to obtain data for this field.

Business Inventory

This field represents the loss due to replacement of business inventory. As part of the project, I was not required to obtain data for this field.

Business Income

This field represents the loss in dollars/day of business income. As part of the project, I was not required to obtain data for this field.

Wages Paid

This field represents the loss in dollars/day of wages paid. As part of the project, I was not required to obtain data for this field.

Relocation Costs

This field represents the loss of the cost of business relocating. As part of the project, I was not required to obtain data for this field.

Rental Costs

This field represents the loss in dollars/day due to rental costs for replacement space. As part of the project, I was not required to obtain data for this field.

Ratio of Building Owner Occupied

This field represents the percentage of the building that is owner occupied. As part of the project, I was not required to obtain data for this field.

Profile Name

This field contains the name of the building profile assigned to each building. The profile is based on 3 supplemental fields of Building Type, Occupancy Class, and Seismic design level. I made the name a combination of the three afore mentioned fields (see Profile name in Figure 1). One reason for this naming convention is that within the HAZUS atmosphere for defining profiles, as you copy the name into the required box, it is very quick and easy to see what other drop down menu items you should select. Another is that the name should be unique. A screen shot, shown as Figure 1, has been included below for clarity. HAZUS will truncate the zip code after 40 characters. *[Editor's note: please refer to the next section in the Mitigation Strategy appendix to review how this use of building profiles was changed subsequent to Jesse's report.]*

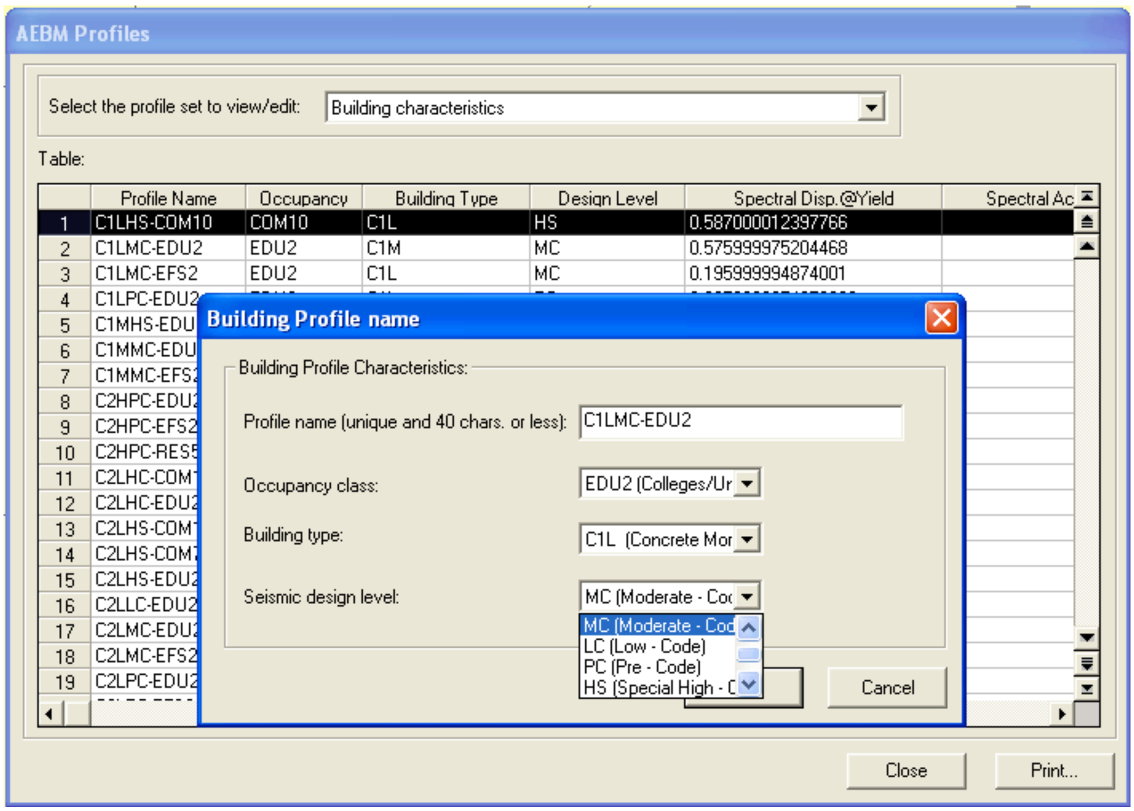


Figure 5: HAZUS profile name creation

Building Classification

This field contains the abbreviation of the type of lateral force resisting system of the building. For a list of the types, see Appendix A to this report.

Seismic Design Level

This field contains the level of seismic design to which the building was designed with the codes available at the time of design and construction. The levels can be determined by benchmark years, as described later, for seismic codes. The levels include: Pre Code PC, Low Code LC, Special Low Code SL, Moderate Code MC, Special Moderate Code, High Code HC, and Special High Code HS. Other criteria need to be taken into consideration when assigning the seismic design level such as any seismic upgrades that the building went through from remodels or other rehabilitations. Also used to determine the seismic design level are the building's characteristics such as soft story, torsion, vertical irregularities, pounding, and others as listed in the "Building List Creation" section, discussed previously in this report. This assignment is extremely critical for obtaining meaningful results as it greatly affects the behavior and damage of buildings during an earthquake and should be looked at very closely by the professional structural engineer.

Occupancy Class

This field contains the occupancy designation for each building and hence profile. As part of the project, I was not required to obtain data for this field.

Number of Stories

This field contains the number of stories for each building. It aids in determining the building classification used in the profile name.

Design Year

This field contains the year of design for each building. It is useful in determining the level of seismic design as described above.

More fields than those listed here were collected for the project but were not used. This was mainly due to the fact it was unknown at the time that the software did not require the use of the extra fields. Although, it may be beneficial to collect more data than is required for special reasons or future needs.

Benchmark Years

It was necessary to determine the appropriate years of code changes for the region surrounding the University of Utah. The reason is that over the years, seismic design has become increasingly better due to experience from past earthquakes. The professional structural engineer mentioned in this report is the one who helped me pinpoint these crucial years. Because of his great experience he was able to give me the benchmark years. As an example, the benchmark years for the University of Utah region are as follows:

Table 20: Seismic design level benchmark years for Utah

Seismic Design Level		Benchmark Year
PC	Pre code	Pre 1973
LC	Low code	1973-1980
MC	Moderate code	1980-2000

HC	High code	2000-2007
HS	Special high code	As required

HAZUS Installation

HAZUS is a fairly large application and requires a lot of hard disk drive space. In order to run properly, we used a program called ArcGIS 9-ArcMap Version 9.1 with Service Pack 1. The platform on which the program was installed was Windows XP with Service Pack 2. HAZUS will work on many other platforms. FEMA has a web page for technical and installation support at the following address: http://www.fema.gov/plan/prevent/hazus/index.shtm. It is recommended to closely follow the installation instructions in the HAZUS-MH MR2 User's Manual. The installation process takes a few hours to completely load and set up. The software can also be ordered at the same address.

Database Conversion

As I received my initial inventory data, I compiled it into an Excel spreadsheet with the appropriate field headings. As far as putting the building inventory into HAZUS, there are two ways to accomplish this. The first is to individually input each building with all its identifying fields. The other, which is more reasonable for multiple buildings, is to import the inventory from a table. If the second option is preferred, which was the case in this project, a file conversion needs to happen before the data can be imported into HAZUS. To do this import, I uploaded my partially finished Excel inventory list to an FTP site maintained by FEMA. They converted my data to an Access database form with all the required attributes of each field (as there are many). I was then able to easily import all the inventory data into HAZUS. The ftp site is as follows: www.floodmaps.net/eftp. The recipients of the file, as prompted by the ftp site, to do the conversion for this project were Rich Hansen and Douglas Bausch who both have key roles in the development of the HAZUS software.

Once I had the converted file, I could use it to update with the new and incoming building data collected. This way, I did not have to have the file converted every time I received new data. It should be noted that great caution be taken when manipulating the converted file. HAZUS is very particular in the input data and will give errors if the slightest piece of information or attribute setting is incorrect. For example, there cannot be any blank records in the Access database. Also, the latitude and longitude fields have to be unique with respect to other records. Remember the maximum character limits. If there are too many characters, HAZUS won't import data properly.

Uploading and Mapping Inventory

The importing of data into HAZUS is fairly strait forward with the use of the manuals. However, I ran into difficulty with the input of building profiles. As far as I could determine, the only way to enter each profile was to do it manually and one at a time. This procedure is shown in Figure 1. The following figure shows how to access the profile input window. I would recommend finding a way to bulk import or create building profiles.

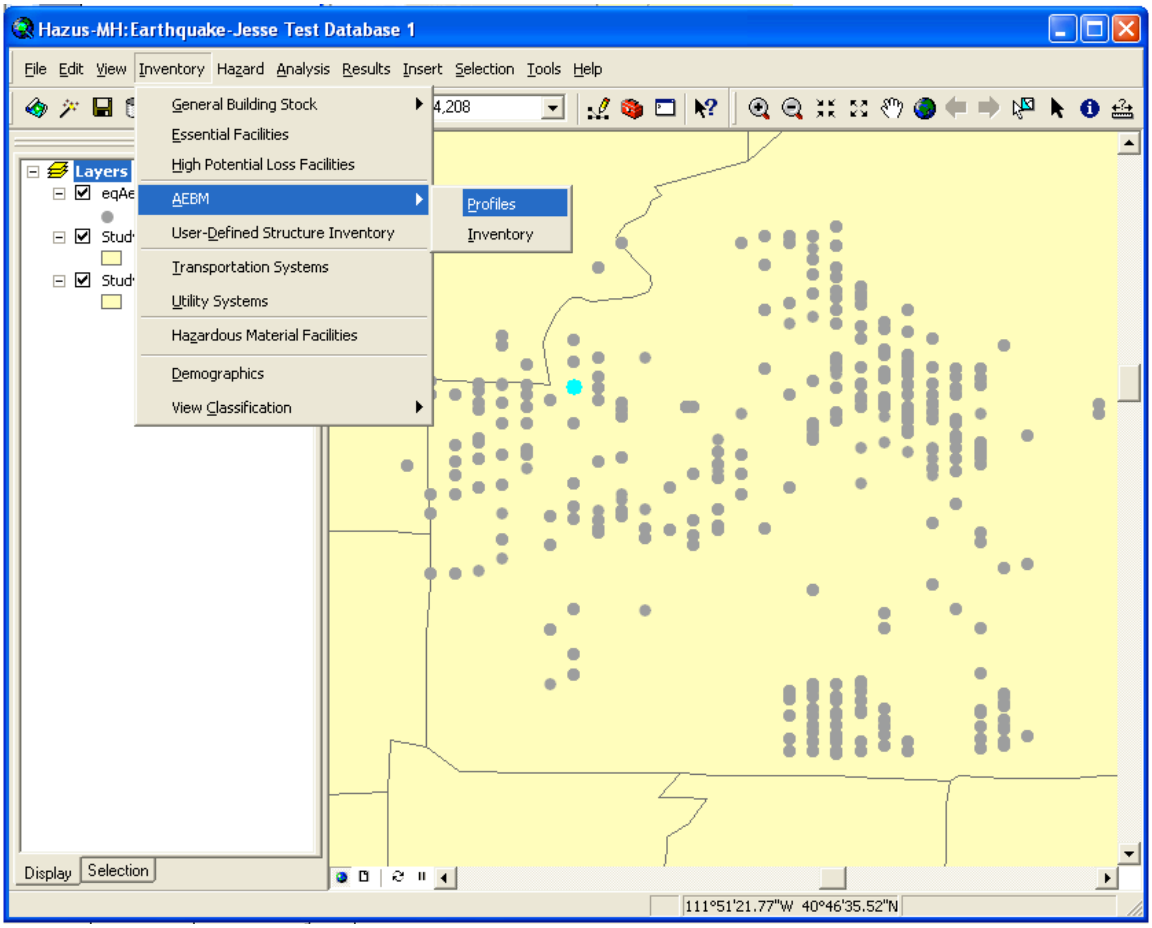


Figure 6 : AEBM Menu for Profile and Inventory options

For importing the building inventory, it is simply right-clicking in the Advanced Engineering Building Module Inventory window and then selecting "Start Editing" followed by the selection of "Import", see Figure 3. You then select the Access database file that contains your building inventory and then the appropriate table from within the file. At this point, a window appears that will ask you to map your field names to those named by HAZUS, see Figure 4 in this report. The program will not continue until you have matched latitude and longitude. These fields are a must for the program to have. Once all fields are matched by highlighting the appropriate fields and clicking the "Add" button, you can then click on save and your inventory will be added to HAZUS, assuming no errors have taken place. In the case of errors, check the inventory for the problems listed in the previous section of this report or get technical support from http://www.fema.gov/plan/prevent/hazus/index.shtm.

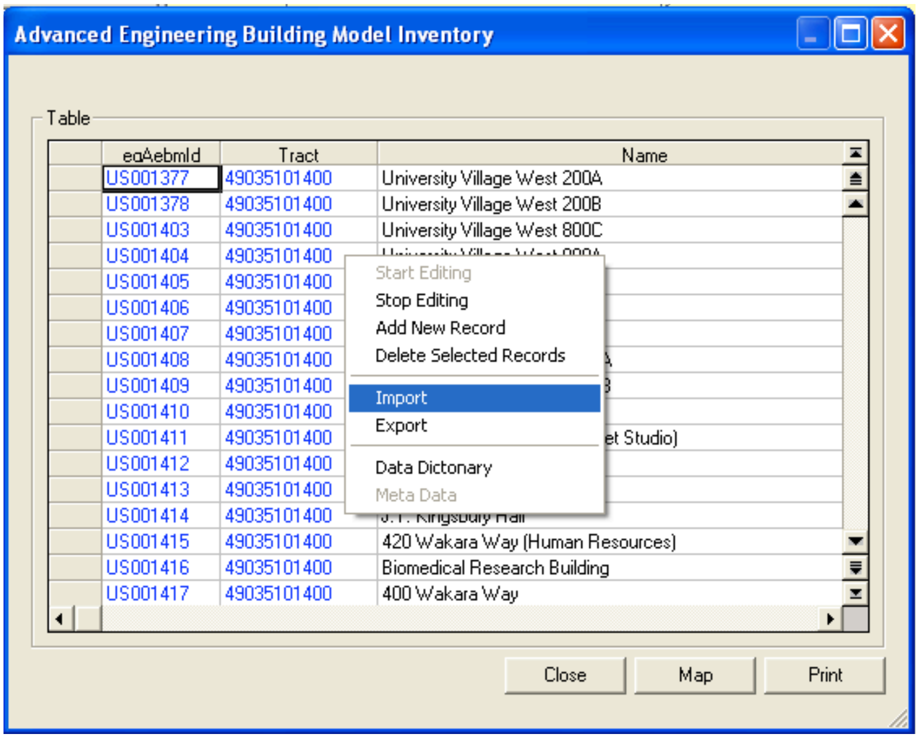


Figure 7: AEBM Import menu (right-click)

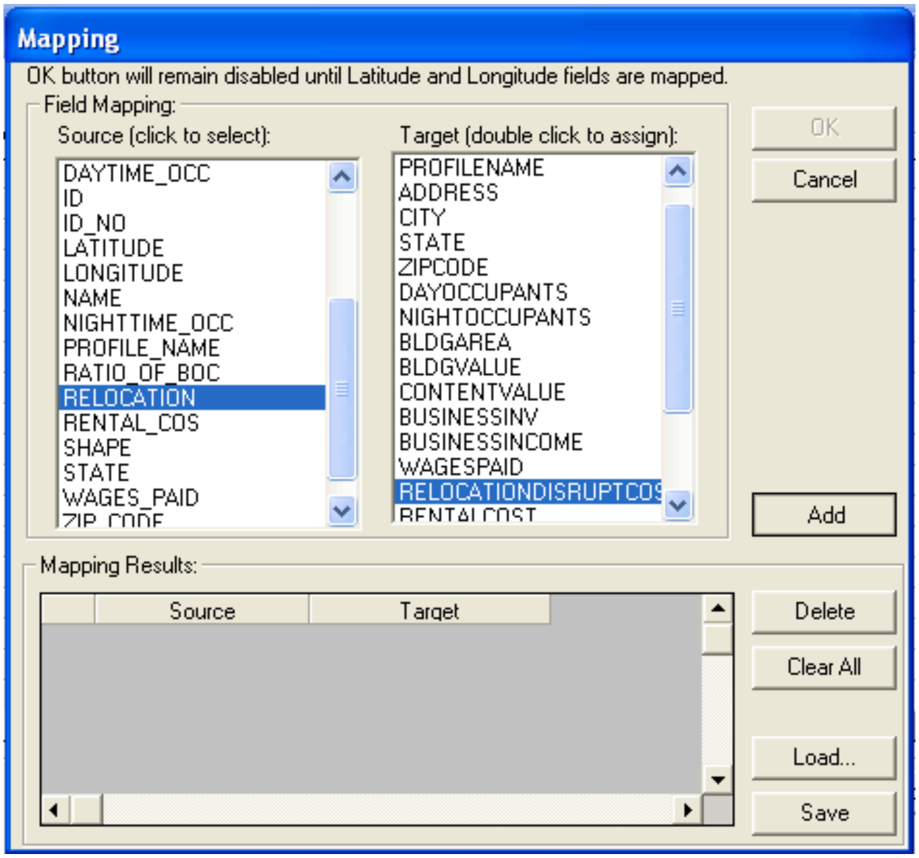


Figure 8: AEBM Inventory Field Mapping Window

Ground Motion Data

For HAZUS to make a complete run of the building information, ground motion values need to be input. Ground motions tables and files are supplied by FEMA when the HAZUS software is ordered. However, the ground motions supplied are based on USGS ground motions for rock. Although these values are an industry standard and acceptable, they are not site-specific. To be considered site-specific, attributes such as soil type, fault type, depth to rock, etc. have to be included. A professional geotechnical engineer is essential in obtaining site-specific ground motion information. For this project, Dr. Stephen Bartlett, of the Civil and Environmental Engineering Department faculty, was available to provide the needed values of site-specific ground motion.

Uploading and Mapping Ground Motion

The first thing to do when adding ground motions to HAZUS is to point the program to the location of the ground motion data maps. To do this, click on the Hazard tab at the top of the program window, and then click on Data Maps. Click on Add Map to List then browse to the database files for ground motion. The files will most likely be named to something similar to the following: HazardData_UGS.mdb, and "Your Region"GroundMotion_UGS.mdb. When you add the Hazard Data map, it will ask for a map name, map type and table name. Only the first 8 map types will be used for these two databases. Select the first Map Type which is "Soil" and then give it a similar name. I just kept the Map Names the same as the Map Types. Do this for Landslide, Liquefaction and Water Depth. Scroll down and add the following table names to the corresponding Map Name and Type: LNDEF_W_Dissolve for Landslides, LQFDEF_Dissolve for Liquefaction, SOILDEF_Dissolve for Soil, and WDPTHDEF_Dissolve for Water Depth. See Figure 5.

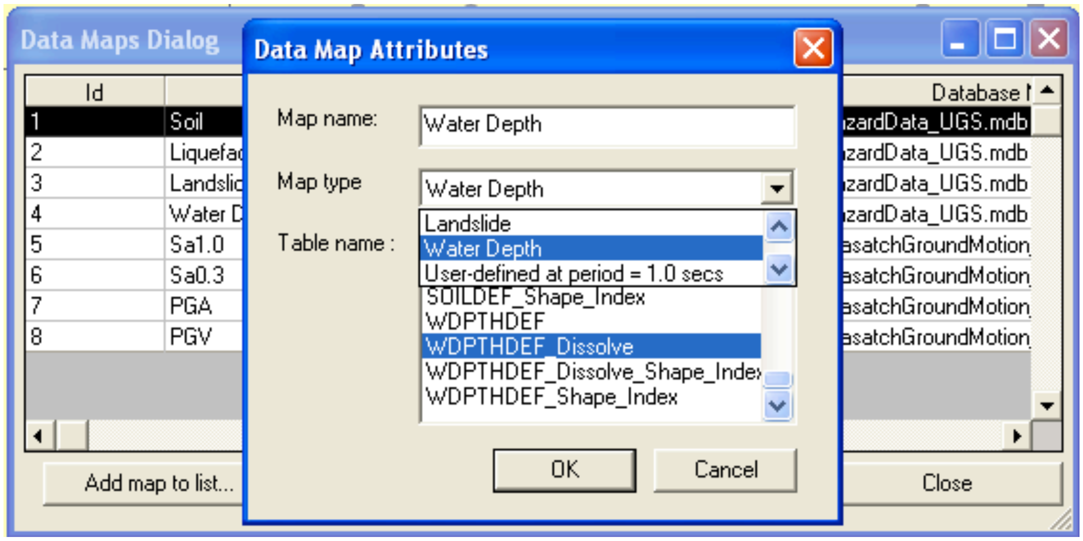


Figure 9: AEBM – Mapping ground motion files

The procedure is the same for the Ground Motion database for your region. The Map Types are: User-defined at period = 1.0 secs, User-defined at period = 0.3 secs, User-defined for pga, and User-defined for pgv. Add the corresponding Map Names as well as Table Names: PGA, pgv, sa03, and sa10.

The second thing to do when adding ground motion to HAZUS is to create a scenario earthquake event. To do this, click on the Hazard tab at the top of the page, and then click on Scenario. Click on Next and then put a check in the box for define a new scenario followed by the next button. Check the button for a user-supplied hazard followed by the next button. Under the Ground Shaking Maps tab, use the drop down menu to select the appropriate maps, see Figure 6. Also, you want to set the appropriate magnitude of the event.

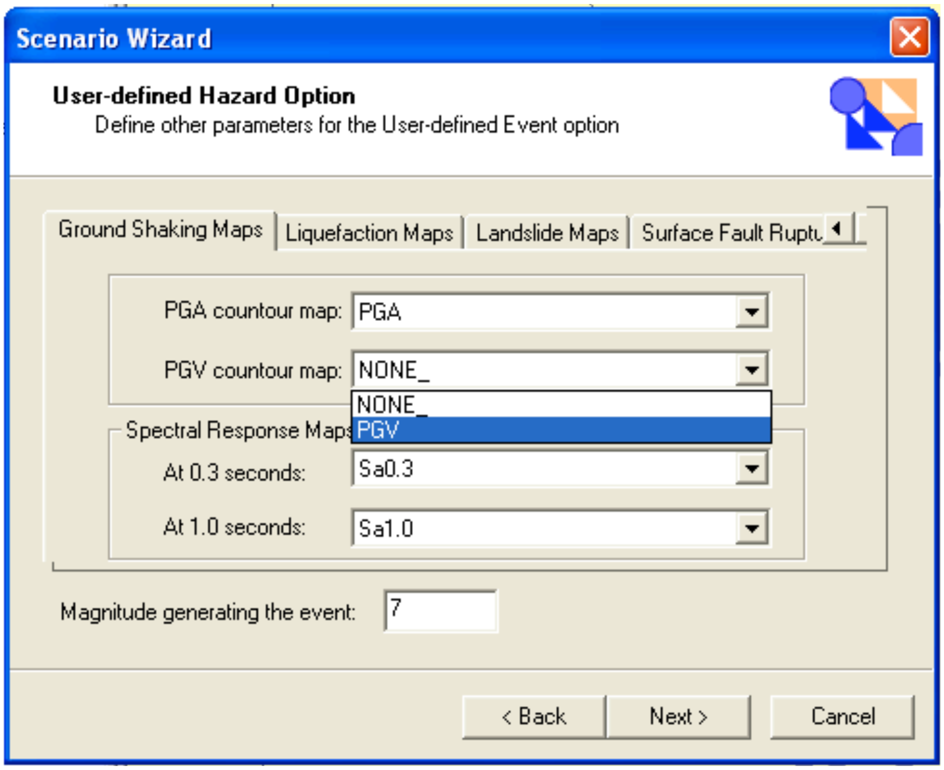


Figure 10: AEBM – Ground motion map input

After clicking next, you will be asked to name the event with a maximum of 40 characters.

To modify the default values with those given by the professional geotechnical engineer, I just opened the ground map Access database files and changed all values to the single value for the specific site since the given data is in a spatial form for a large area (county FIPS area). The ground motion data I entered is based only on one type of earthquake, 2% in 50 years probability of exceedance. It was recommended by the geotechnical engineer to run the model at the 3 levels of ground motion to get the best envelope of results to capture full earthquake damage effects. To get results for other events, 5% in 50 years and 10% in 50 years, the ground data has to be modified for each event. At the time of this report, only the information for the 2% in 50 years was used since there was still incoming information for other non-structural fields. All three cases will be run at a later time in full.

Finally, for a graphical representation of ground motion, you can click on the Hazard tab at the top of the program window, and then click Show Current. Simply select the category you would like to see mapped and then click Map.

Trial HAZUS Runs

Throughout the project, I made several trial runs to make sure data I was collecting was correct and that I was seeing the type of output that I would expect. To perform a run is very simple.

First, click on Analysis at the top of the program screen, and then click on Run. Check the box that says Advanced Engineering Building Module and then click on OK. A window should come up that asks if you want to "Run the analysis with the options selected?" and you should click on Yes. After a few seconds to minutes, the following screen will appear:

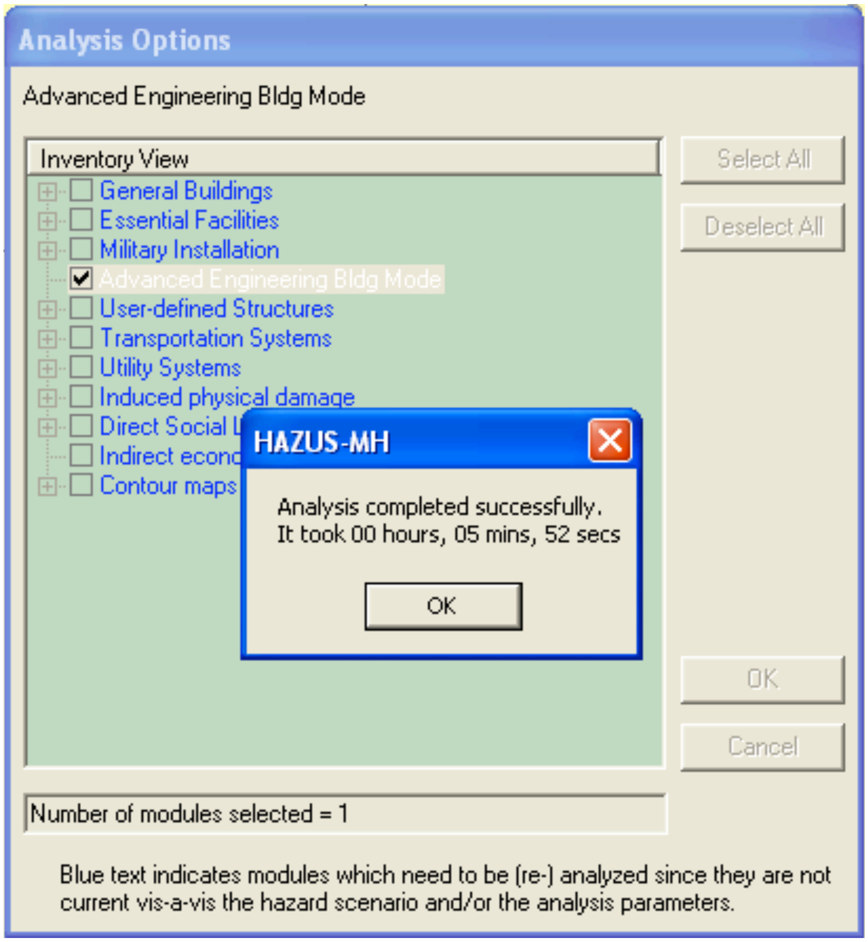


Figure 11: AEBM – analysis complete notification

To see the HAZUS generated building reports first click on the Results tab at the top of the program screen. Second, click on Summary Reports followed by clicking on the tab labeled as Other. You can then select one of two options: AEBM-Individual Building Report (See Appendix B of this report), or AEBM-Portfolio Building Report (See Appendix C of this report). These files can be exported to an Excel file, Adobe PDF, or a variety of formats. Another option for output is to click on the Results tab at the top of the program screen, and then click on Advanced Engineering Building Module (AEBM). This window will show all results of all buildings in a tabular form. The fields of output can be mapped visually on GIS by selecting the appropriate field name, and then clicking on Map. Also, the information can be printed or made to a PDF or other image format document.

Final HAZUS Run

I was unable to perform a final run for the project. The reason for this is that much of the non-structural data was not yet available. The non-structural team worked hard at getting all needed data before I left the project. They kept me informed at to their progress and were very helpful. I would recommend for future projects to start gathering this data as early as possible as it is a long process to gather and sort non-structural data.

Although I was not around to make the final runs, I was able to help the management set up a HAZUS "workhorse" that will be accessible to those involved in the project through an internet connection. I instructed those who will be doing the further analysis how to use HAZUS. I am confident that the project will continue in the positive direction that it has been moving.

[Editor's note: Responsibility for the HAZUS runs was transferred from Civil Engineering to the DIGIT lab, a GIS recharge center housed in the Department of Geography.]

Documentation and Reporting

As always, documentation of projects is very important. Throughout the project, I have made comments about individual buildings based on our findings. These comments were located in the main inventory spreadsheet form and could not be included in the imported data used by HAZUS. This information, available in the project files at the University of Utah, can be very useful for another study that may occur years from now for knowledge on why and by what reasoning buildings were profiled as they were. Also, in the case of this project, it is very useful information because my time in it expired before any final runs were able to be completed. Others will be able to use this report and other comments and documentation such as databases, spreadsheets and file photos to know what the structural team has done.

Conclusion

By following a scheme such as the one this report outlines, a structural seismic hazard risk assessment team can be successful in their goals.

Appendix A - Plan Room Data Gathering Worksheet

Type	Stories	Description
W1	1-2	Wood, Light Frame (<= 5,000 sq. ft.)
W2	ALL	Wood, Greater than 5,000 sq. ft.
S1L	1-3	Steel Moment Frame
S1M	4-7	
S1H	8+	
S2L	1-3	Steel Braced Frame
S2M	4-7	
S2H	8+	
S3	ALL	Steel Light Frame
S4L	1-3	Steel Frame with Cast-in-Place Concrete Shear Walls
S4M	4-7	
S4H	8+	
S5L	1-3	Steel Frame with Unreinforced Masonry Infill Walls
S5M	4-7	
S5H	8+	
C1L	1-3	Concrete Moment Frame
C1M	4-7	
C1H	8+	
C2L	1-3	Concrete Shear Walls
C2M	4-7	
C2H	8+	
C3L	1-3	Concrete Frame with Unreinforced Masonry Infill Walls
C3M	4-7	
C3H	8+	
PC1	ALL	Precast Concrete Tilt-Up Walls
PC2L	1-3	Precast Concrete Frames with Concrete Shear Walls
PC2M	4-7	
PC2H	8+	
RM1L	1-3	Reinforced Masonry Bearing Walls with Wood or Metal Deck Diaphragms
RM1M	4+	
RM2L	1-3	Reinforced Masonry Bearing Walls with Precast Concrete Diaphragms
RM2M	4-7	
RM2H	8+	
URML	1-2	Unreinforced Masonry Bearing Walls
URMM	3+	

Building			
Stories			
Year Built			
Design Engineer			
Basement	Yes	No	
Foundation Type			
Falling Hazard	Yes	No	
*Vertical Irregularity	Yes	No	
Soft Story	Yes	No	
**Torsion	Yes	No	
***Plan Irregularity	Yes	No	
†Pounding	Yes	No	
Large Heavy Cladding	Yes	No	
Condition	Poor	Fine	Great
Comments			

* Steps in elevation view; inclined walls; building on hill; soft story (e.g., house over garage); building with short columns; unbraced cripple walls.

** Corner or wedge buildings or any type of building in which the lateral load resisting system is highly non symmetric or concentrated at some distance from the center of gravity of the building.

*** Buildings with re-entrant corners (L, T, U, E, +, or other irregular building plan); buildings with good lateral resistance in one direction but not in the other direction; eccentric stiffness in plan, (e.g., corner building, or wedge-shaped building, with one or two solid walls and all other walls open.)

† Floors of adjacent buildings differ in height, impacting columns.

Figure 12: Plan room data-gathering worksheet

Appendix B - AEBM-Individual Building Report

HAZUS AEBM- Individual Building Report

4/23/2007

Building Information

Id Number:	US001446
Building Name:	Student Services Building
Address:	201 S 1460 E
Latitude / Longitude:	40.77/-111.85
Building Profile:	C1MMC-EDU2

Ground Motion

SA @ 0.3 seconds (g) :	1.65
SA @ 1.0 seconds (g) :	1.20
PGA (g) :	0.85
Soil Type :	

Building Intersection Points

Displacement (in) :	9.88
Acceleration (g) :	0.49

Building Damage

Damage State	Damage State Probabilities (%)		
	Structural	Non-Structural Drift	Non-Structural Acceleration
None	0.0	1.0	12.0
Slight	2.0	7.0	27
Moderate	28.0	44.0	27
Extensive	44.0	22.0	14
Complete	25.0	25.0	20

Casualties

Casualty Level	Estimated Number of Occupants & Casualties		
	Description	Day Time Scenario	Night Time Scenario
Occupants	# of people in building	500	10
Level 1	Requires Medical Attention	13	0
Level 2	Requires Hospitalization	4	0
Level 3	Life Threatening Injury	1	0
Level 4	Death	1	0

Economic Loss

Loss Category	Building Exposure & Economic Loss		
	Exposure($)	Loss ($)	Damage Ratio
Building-Structual		548	5.51
Building-Nonstructual	9,954	3,239	32.54
Contents	8,615	1,301	15.10
Business Interruption		300,858	
Total	18,569	305,946	

Disclaimer: The estimates of economic and social losses contained in this report were produced using HAZUS loss estimation methodology software, which is based on current scientific and engineering knowledge. There is uncertainty inherent in any loss estimation methodology. Therefore, there may be significant differences between modeled results contained in this report and actual economic and social losses associated with earthquakes.

Study Region : Jesse Test Database 1
Scenario : Jesse Test 1

Figure 13: AEBM individual building report

Appendix C - AEBM-Portfolio Building Report

HAZUS AEBM- Portfolio Buiding Report

4/23/2007

Building Information

Total Number of Buildings Analyzed: 276

Ground Motion & Building Intersection Points

Damage State	Ground Motion and Building Intersection Points		
	Minimum	Maximum	Average
Ground Motion			
SA @ 0.3 seconds (g)	0.75	2.30	1.95
SA @ 0.1 seconds (g)	0.60	0.60	0.93
PGA (g)	0.55	1.05	0.89
Building Intersection Points			
Displacement (in)	1.48	64.92	9.76
Acceleration (g)	0.25	1.01	0.62

Building Damage

Damage State	Damage State Probabilities (%) *		
	Structural	Non-Structural Drift	Non-Structural Acceleration
None	6.14	7.97	10.77
Slight	16.54	15.00	23.01
Moderate	27.74	30.94	23.50
Extensive	16.95	11.88	16.44
Complete	32.61	34.17	26.26

*Average Damage State Probabilities weighted by the building value of each building.

Casualties

Casualty Level	Estimated Number of Occupants & Casualties		
	Description	Day Time Scenario	Night Time Scenario
Occupants	# of people in building	138,000	2,760
Level 1	Requires Medical Attention	7,334	147
Level 2	Requires Hospitalization	2,416	48
Level 3	Life Threatening Injury	418	8
Level 4	Death	827	17

Economic Loss

Loss Category	Building Exposure & Economic Loss		
	Exposure($)	Loss ($)	Damage Ratio
Building-Structual	2,116,469	117,044	5.53
Building-Nonstructual		736,850	34.82
Contents	804,222	242,147	30.11
Inventory	0	0	0.00
Total	2,920,691	1,096,040	37.53

Disclaimer: The estimates of economic and social losses contained in this report were produced using HAZUS loss estimation methodology software, which is basec on current scientific and engineering knowledge. There is uncertainty inherent in any loss estimation methodology. Therefore, there may be significant differences between modeled results contained in this report and actual economic and social losses associated with earthquakes.

Study Region : Jesse Test Database 1
Scenario : Jesse Test 1

Figure 14: AEBM portfolio building report

I.3.2 Non-Structural

I.3.2.1 Rapid Visual Screening – Non-Structural

I.3.2.1(a) ACSA2007 Paper

The following paper was written by Ryan Smith (co-principal investigator) and Pat Tripeny and submitted for the Association of Collegiate School of Architecture 2007 annual meeting.

Note: Figures have been re-numbered to correlate with the main document.

The Development and Implementation of a Rapid Visual Screening Method for Non-Structural Damage due to Seismic Forces

INTRODUCTION

Non-structural building components are the systems and components of a building that are not directly used within the primary structural building system. Non-structural components include non-bearing walls, pipes, ducts, lighting, parapets, doors, windows, shelving, etc. The reality is that a relatively small percentage of a building's cost goes into structural systems. The structural cost of a typical office building is only 18% of the total cost with non-structural components being 62% and the content of the building being 20% (Whittaker 2003). Seismic damage to a building's non-structural elements can not only be costly but can also be a life safety issue to the building's occupants when a non-structural element fails to remain in place and can be a life safety issue to a community if the failure of a non-structural element causes a toxic element to be released from a building.

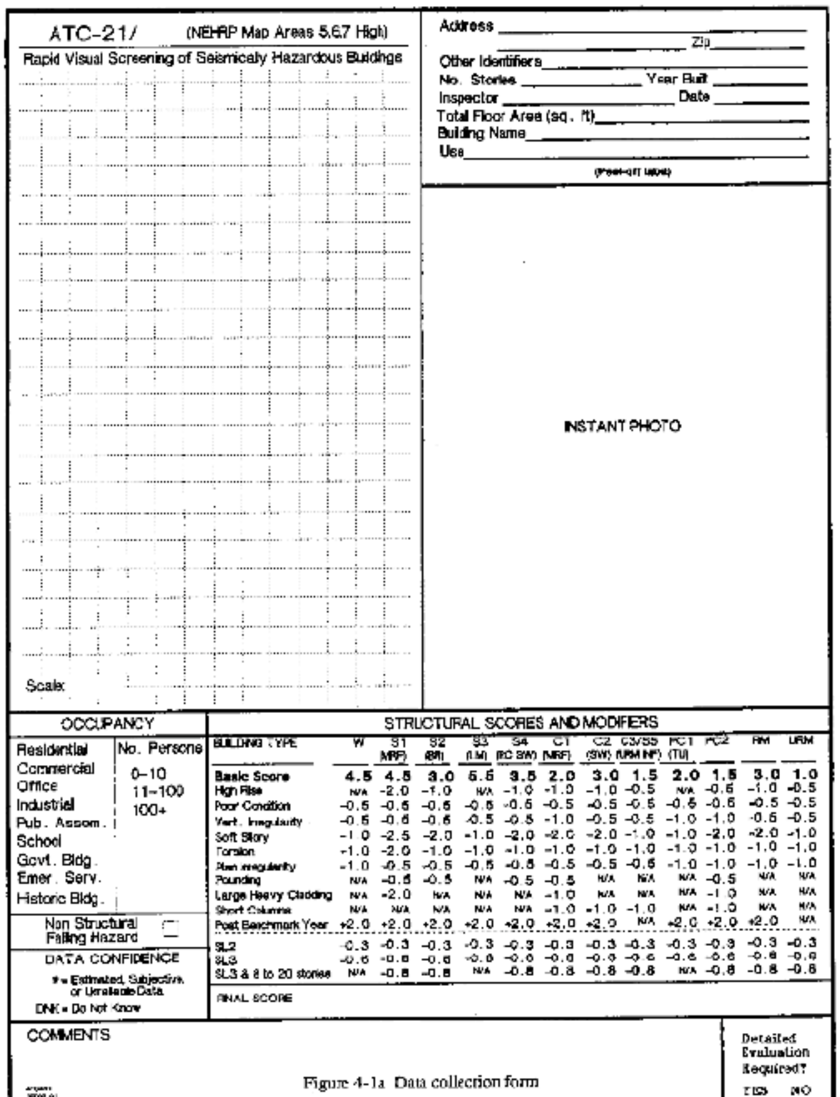
The issue of non-structural damage due to seismic events first became apparent after the Great Alaskan earthquake of 1964 and was reemphasized by the San Fernando earthquake of 1971 and the 1972 earthquake in Managua, Nicaragua (Mertz 1976). In these earthquakes, structural components suffered relatively little damage while the non-structural damage was extensive. The building codes were revised after these earthquakes to require non-structural elements to be tied back to the structure in such away to reduce the potential of harming people during an earthquake (ICBO 1973). These building codes have been updated many times in the last 35 years to reduce these chances further and to address such issues as hazardous materials.

The problem that had not been addressed is the need for a method to identify buildings that may be potentially dangerous from a non-structural aspect of seismic design from a large pool of buildings within a city or a part of a city such as a university campus. This method needs to be relatively quick and needs to be done by people with a relatively small amount of training. This paper will describe the research carried out at a university to develop and test such a system. The non-structural rapid visual screening method was used to evaluate the building stock owned by the University in order to assist in the prioritization of building remodeling expenditures with regards to seismic safety on campus.

BACKGROUND FOR RAPID VISUAL SCREENING FOR SEISMIC EVALUATION OF BUILDINGS

The rapid visual screening (RVS) method for quick evaluation of buildings based upon their structural systems was developed by the Applied Technology Council (ATC) in conjunction with the Federal Emergency Management Agency (FEMA) in 1987-88

(FEMA 1988). The method developed was intended to "provide a tool to evaluate the danger of building collapse due to earthquakes, … a method whereby buildings can be rapidly identified via a 'sidewalk survey' as seismically acceptable or potentially seismically hazardous" (FEMA 1988, pg. 1). The tool (Figure 1) developed allows a minimally trained surveyor to examine a building without ever entering the building and to evaluate it based upon its age, structural system type and irregularities, soil type and condition. The surveyor also can note the occupancy type and load and whether non-structural falling hazards exist but these items are not part of evaluating the building based upon its potential to collapse.



ATC-21 (NEHRP Map Areas 5,6,7 High)
Rapid Visual Screening of Seismically Hazardous Buildings

Scale:

Address
Zip
Other Identifiers
No. Stories
Year Built
Inspector
Date
Total Floor Area (sq. ft)
Building Name
Use

INSTANT PHOTO

OCCUPANCY

Occupancy	No. Persons
Residential	0–10
Commercial	11–100
Office	100+
Industrial	
Pub. Assem.	
School	
Govt. Bldg.	
Emer. Serv.	
Historic Bldg.	

Non Structural Falling Hazard

DATA CONFIDENCE
* = Estimated, Subjective, or Unreliable Data
DNK = Do Not Know

STRUCTURAL SCORES AND MODIFIERS

BUILDING TYPE	W	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	C1 (MRF)	C2 (SW)	C3/S5 (URM INF)	PC1 (TU)	PC2	RM	URM
Basic Score	**4.5**	**4.5**	**3.0**	**5.5**	**3.5**	**2.0**	**3.0**	**1.5**	**2.0**	**1.5**	**3.0**	**1.0**
High Rise	N/A	-2.0	-1.0	N/A	-1.0	-1.0	-1.0	-0.5	N/A	-0.5	-1.0	-0.5
Poor Condition	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Vert. Irregularity	-0.5	-0.5	-0.5	-0.5	-0.5	-1.0	-0.5	-0.5	-1.0	-1.0	-0.5	-0.5
Soft Story	-1.0	-2.5	-2.0	-1.0	-2.0	-2.0	-2.0	-1.0	-1.0	-2.0	-2.0	-1.0
Torsion	-1.0	-2.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Plan Irregularity	-1.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-1.0	-1.0	-1.0	-1.0
Pounding	N/A	-0.5	-0.5	N/A	-0.5	-0.5	N/A	N/A	N/A	-0.5	N/A	N/A
Large Heavy Cladding	N/A	-2.0	N/A	N/A	N/A	-1.0	N/A	N/A	N/A	-1.0	N/A	N/A
Short Columns	N/A	N/A	N/A	N/A	N/A	-1.0	-1.0	-1.0	N/A	-1.0	N/A	N/A
Post Benchmark Year	+2.0	+2.0	+2.0	+2.0	+2.0	+2.0	+2.0	N/A	+2.0	+2.0	+2.0	N/A
SL2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
SL3	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
SL3 & 8 to 20 stories	N/A	-0.8	-0.8	N/A	-0.8	-0.8	-0.8	-0.8	N/A	-0.8	-0.8	-0.8

FINAL SCORE

COMMENTS

Detailed Evaluation Required?
YES NO

Figure 4-1a Data collection form

Figure 15: Rapid Visual Screening Evaluation (FEMA 1988, pg. 54)

The RVS method was designed to be carried out by a surveyor who has had some training at identifying various aspects of a building from the street without going into it. These aspects include the building's age, structural type, condition, plan and vertical irregularities, occupancy, size, and soil type. The accuracy of the survey can be increased by determining many of these items in advance using tools such as Sanborn Maps, geological maps and building permit documents. When a surveyor is finished with the RVS method the building is assigned a score. Depending on the depth of the survey being conducted and the amount of information collected before the street survey begins, this process can take between ten and thirty minutes per building.

The purpose of the survey is to determine the likelihood of a building to collapse during an earthquake. The building's final score is that indicator. The larger the number of the final score, the less likely that the building will collapse while the smaller the number the more likely it will happen. The scale of the survey is approximately a 16-point scale with the high score being a 10.5 in regions with low seismic activity and the high score being a 7.5 in regions with high seismic activity. No single number is given to determine when a building has crossed over from being a building within the normal range and when it is a building with a score low enough to be of concern. This is usually determined for each study using statistical methods of analysis.

The RVS method has been used many times since its development and has become the standard for determining the seismic readiness of buildings of interest. It has proven useful when looking at large numbers of buildings such as a city or university. It has been modified by FEMA and ATC over the years as needed and has been modified by groups of researchers to meet their particular needs. Portland, Oregon was the first city in the country to survey its entire building stock for seismic readiness and the State of Oregon has just completed surveying every educational and emergency facility in the state (Lewis 2007). It has become an invaluable tool but one limited by its original objective which was to determine the likelihood of a building to collapse during a seismic event.

DEVELOPMENT OF A RAPID VISUAL SCREENING METHOD FOR NONSTRUCTURAL SYSTEMS

The rapid visual screening method for non-structural systems (RVS-NS) is not to be a replacement to the earlier RVS method but to be a compliment to it. Much of the data necessary to complete the RVS-NS is already collected during the process of completed the RVS study but is not used to evaluate the building since this information would not aid in process to determine if the building is likely to collapse. The goal of the RVS-NS study is to evaluate a building for potential failure of the non-structural systems, which could be a risk to life safety, property, and building function.

Life safety is obviously the most important of the risks due to non-structural failure and the RVS-NS (Figure 2) considers this by establishing the base score for the building on its occupancy. The more people inside a building during an earthquake, the more likely someone will be injured during the event. The base scores range from 10 points for fewer than 10 occupants in the building to 6 points for more than 10,000 people.

Photograph

Building Name__________________
Building Number ________________
Total Floor Area _________________
Year Built _____________________

Non-Structural Score _________ pts.
Life Safety Percentage _____ %
Property Percentage _____ %
Function Percentage _____ %

Occupancy Types and Loads

Type	Occupancy Load	Gross Floor Area (sq. ft.)	Number of Occupants
Agricultural	1 per 300 sq. ft.		
Assembly			
Fixed Seating	1 per sear		
Non Fixed			
- Chairs only	1 per 7 sq. ft.		
- Standing	1 per 5 sq. ft.		
- Chairs & Tables	1 per 15 sq. ft.		
Bowling	5 per lane		
Business Areas	1 per 100 sq. ft.		
Dormitories	1 per 50 sq. ft.		
Educational			
Classrooms	1 per 30 sq. ft.		
Shops & Vocational Rooms.	1 per 50 sq. ft.		
Exercise	1 per 50 sq. ft.		
Fabrication and Manufacturing	1 per 200 sq. ft.		
Industrial	1 per 100 sq. ft.		
Institutional			
Inpatient Treatment	1 per 240 sq. ft.		
Outpatient	1 per 100 sq. ft.		
Sleeping	1 per 120 sq. ft.		
Kitchens - commercial	1 per 200 sq. ft.		
Laboratory	1 per ??? sq. ft.		
Library			
Reading Rooms	1 per 50 sq. ft.		
Stacks	1 per 100 sq. ft.		
Lockers	1 per 50 sq. ft.		
Mercantile			
Basement and First Floor	1 per 30 sq. ft.		
Other Floors	1 per 60 sq. ft.		
Storage, stock, shipping	1 per 300 sq. ft.		
Parking Garages	1 per 200 sq. ft.		
Residential	1 per 200 sq. ft.		
Skating Rinks & Swimming Pools			
Rink or pool	1 per 50 sq. ft.		
Decks	1 per 15 sq. ft.		
Stages and Platforms	1 per 15 sq. ft.		
Accessory Storage & Mechanical	1 per 300 sq. ft.		
Warehouse	1 per 500 sq. ft.		
Remaining Area	1 per 100 sq. ft.		
Totals			

Non-Structural Scores

Category	Description	Points
Base Score based upon Occupancy	0 to 10 people = +10 pts. 11 to 100 people = + 9 pts. 101 to 1000 people = + 8 pts. 1001 to 10,000 people = + 7 pts. Greater than 10,001 people = + 6 pts.	
Life Safety		
Occupancy	Hours of Occupancy Greater than 18 hrs.per day = - 0.25 Inability of occupants to egress on their own = - 0.25	
Hazardous Materials	Hazard to people in building = - 0.5 Hazard to Campus = - 0.75 Hazard to Greater Population = - 1.0	
Falling Hazards	Shelving and content = -0.25 pts Pre 1973 construction = - 0.25 pts	
Property		
Content	Large Monetary Value = -0.5 pts. Very Important Content = -0.5	
Non-Structural Damage	Ductile Structure = -0.5 pts. Pre-1973 Construction = -0.5 pts.	
Function		
Importance	Important to Neighborhood = - 0.5 pts. Important to City = - 1.0 pts.	
Ability to operate without connection to outside community	Can partially function = - 0.5 Can not function = -1.0 pts.	
Total		

Notes

Figure 16: Rapid Visual Survey for Non-Structural Elements

Once the building's base score is established, points are deducted as determined by the surveyor based upon what is observed. Life safety is the first area for which points can be deducted. First is to determine if the building is occupied more than 18 hours a day. If it is, then it is more likely that if an earthquake happens, the building will be occupied. Next, the occupants themselves need to be examined to see if they can egress from the building on their own or if they would need help. Examples of occupancies that would need help would include daycare centers, retirement homes, and hospitals. The presence of hazardous or toxic material within a building could pose threat to life safety and the surveyor needs to determine the extent of that threat. Finally, the existence of falling hazards needs to be assessed. This is accomplished by determining if they are present in the form of content such as shelving and whether the building predates building codes that required the bracing of non-structural elements such as ducts and lights. In the area of study, the code in effect at the time of most of the buildings being build was the Uniform Building Code, which first required bracing in 1973 (ICBO 1973). The potential deduction for "Life Safety" is 2 points from the base score.

The "Loss of Property" is the next area evaluated by the RVS-NS. This is accomplished by examining the content to determine if it is valuable and then examining the building to see if the content is in danger due to non-structural failure. The building's content is determined to be valuable if it is either monetarily valuable or if non-monetarily valuable. An example of a non-monetarily valuable object would be an object that has historic significance such as journal of a western pioneer during the mid-1800s. Its historic value may be large while its monetary value may be only a couple hundred dollars. The evaluation of the building is whether it has a ductile structure since moving more during an earthquake and whether it predates the bracing requirements of the relevant building code. The potential deduction for "Loss of Property" is 2 points.

The final area of evaluation is for "Loss of Function." It is given that the function of every building is important to the occupants of that building. The survey is interested in whether the function of the building is important to more than the occupants of the building. A house is clearly important to the family that lives inside it but probably is not as important to those down the block. A firehouse is important to not only the persons working in the building but also the city or region served. The more important the function of the building is, the more points deducted by the survey. Finally, the surveyor needs to determine if the function of the building can happen even if the building is cut off from community services such as water, sewer, electricity, phone, etc. An emergency phone center could not function without phone service but probably could function, at least for a time, without sewer and water. A house without any of the services can at least partially function after an earthquake as long as the building is not in danger of collapse. The less a building can function after the event, the more points are deducted. The potential deduction for "Loss of Function" is also 2 points.

The final evaluation of the building determined in a final "Non-Structural Score" and is based on three percentages, which aid in determining whether a building is problematic due to life safety, loss of property, or loss of function. The "Non-Structural Score" is determined by subtracting any deductions from the base score. Like the RVS score, the RVS-NS score is interpreted as the smaller the number, the greater the propensity of failure in the building. The percentages given for each of the three non-structural problems are each based upon the number of points deducted in an area divided by the possible number of points in the area. These scores can help differentiate between two buildings with similar score. Figure 3 demonstrates the usefulness of this process. The evaluation on the left is an educational / laboratory building while the one on the right is a large library. They were both built in the same year and both were given a Non-Structural Score of 5.0. Without the additional information given by the percentages, the two buildings would be considered similar.

With the percentages, one can quickly determine that the primary problem with the laboratory building is life safety while with the library it is loss of function. This additional information could be very useful to someone who is trying to make a decision on which building should be remodeled first.

Building Name	Fletcher Building
Building Number	83
Total Floor Area	76153
Year Built	1965
Non-Structural Score	5.00
Life Safety Percentage	75.0%
Property Percentage	25%
Function Percentage	50%

Non-Structural Scores

Category	Description	Points
Base Score based upon Occupancy	1 to 10 people = +10 pts. 11 to 100 people = +9 pts. 101 to 1000 people = +8 pts. 1001 to 10,000 people = +7 pts. Greater than 10,001 people = +6pts.	5
		5
Life Safety		
Occupancy	Hours of Occupancy Greater than 18 hrs. per day = -0.25	-0.25
	Inability of occupants to egress on their own = -0.25	0
Hazardous Materials	Hazard to people in building = -0.5 Hazard to Campus -0.75 Hazard to Greater Population = -1.0	0 -0.75 0
Falling Hazards	Shelving and content = -0.25 pts.	-0.25
	Pre-1974 Construction = -0.25	-0.25
Property		
Content	Large Monetary Value = -.05	0
	Very Important Content -- -0.5	0
Non-Structural Damage	Ductile Structure = -0.5 pts.	0
	Pre-1974 Construction = -0.5	-0.5
Function		
Importance	Important to Campus = -0.5 Important to Region -1.0	-0.5 0
Ability to operate without connection to outside community	Can partially function = -0.5 Can not function = -1.0	0 0 -0.5
Totals		5.00

Notes

Building Name	Library
Building Number	86
Total Floor Area	508094
Year Built	1965
Non-Structural Score	5.00
Life Safety Percentage	25.0%
Property Percentage	50%
Function Percentage	75%

Non-Structural Scores

Category	Description	Points
Base Score based upon Occupancy	0 to 10 people = +10 pts. 11 to 100 people = +9 pts. 101 to 1000 people = +8 pts. 1001 to 10,000 people = +7 pts. Greater than 10,001 people = +6pts.	5
		5
Life Safety		
Occupancy	Hours of Occupancy Greater than 18 hrs. per day = -0.25	0
	Inability of occupants to egress on their own = -0.25	0
Hazardous Materials	Hazard to people in building = -0.5 Hazard to Campus -0.75 Hazard to Greater Population = -1.0	0 0 0
Falling Hazards	Shelving and content = -0.25 pts.	-0.25
	Pre-1974 Construction = -0.25	-0.25
Property		
Content	Large Monetary Value = -.05	-0.5
	Very Important Content = -0.5	0
Non-Structural Damage	Ductile Structure = -0.5 pts	0
	Pre-1974 Construction = -0.5	-0.5
Function		
Importance	Important to Campus = -0.5 Important to Region -1.0	0 -1
Ability to operate without connection to outside community	Can partially function = -0.5 Can not function = -1.0	0 0 -0.5
Totals		5.00

Notes

Figure 3: RVS-NS Evaluation of Two Buildings with the Same Non-Structural Score

INITIAL TESTING OF RAPID VISUAL SCREENING NON-STRUCTURAL METHOD

The initial testing of the RVS-NS method was on a large western university campus. The location was chosen since it is the authors' university and all of the data was readily available but also because it had previously had a RVS study performed by an outside engineering consulting firm in 1989, which was also available to the authors.

All buildings owned or operated by the University where part of the original scope of the study but in the end 126 buildings comprised the survey. *[Editor's note: The 126 building referred to here were those that were surveyed for the RVS paper, while more than double that number were inventoried for the AEBM analysis.]* The occupancy groups included industrial, classroom, laboratory, medical, office and sports facilities. The floor areas of the buildings ranged from 80 square feet to 600,000 square feet with a median size of 41,500 square feet. The number of occupants ranged from 0 to 45,000 people. The oldest building was built in 1900 and the latest was in 2006 with half of the buildings being built before 1967.

The data for the survey was mainly collected from various offices on campus by research assistants. This data included floor areas, occupancy loads, occupancy types, existence of hazardous materials and the determination on how hazardous they were, the year of construction, the value of content, the type of structural system, and the building's importance to the campus, the city and the state. This data was collected from Summer 2006 to Summer 2007 and the evaluation of that data was completed in August 2007.

The Non-Structural Scores where the primary evaluation tool used on the 126 buildings. The median score was 6.25 points with the high score being 9.25 points and the low score being 3.0 points. Using statistical methods to analyze this data, the buildings were categorized into three areas: Buildings of Considerable Concern, Buildings within a Normal Range of Concern, and Buildings of Little Concern. The number of buildings in each of these categories was 15, 88, and 23 respectively. The 15 Buildings of Considerable Concern belong to five occupational types: Sports, Theater, Classroom, Educational / Laboratory, Administrative, and Retail. The sport facilities accounted for a third of these buildings. These buildings tend to be high occupancy, expensive buildings that are important to the University in terms of revenue and important to the city and region as large emergency evacuation centers. In all cases, it was the Function Percentage that controlled these buildings. Four educational / laboratory facilities were of considerable concern with life safety being the determining factor for all them. Each of these building contains hazardous materials that varied in their degree of hazard. The classroom building and one of the retail buildings were loss of property concerns and the last two buildings were loss of function issues.

In comparing this study to the earlier RVS study of 1989, one building was on both lists for buildings of concern. This building is the University Bookstore, a substantial portion of which was built in 1960, of mainly unreinforced masonry. It was a concern to the engineers because of its structural system and it was a concern to the architects because of the potential loss of function to the University. Many of the other buildings of concern to the architects where built in the post-war era and were built with steel moment frames. These buildings did not concern the engineers since they were of little danger of collapse. They were of issue from a non-structural standpoint since they are very ductile and many of them predate the1973 Uniform Building Code changes having to do with the bracing of non-structural elements. The buildings of concern to the engineers but not to the architects tended to also be post-war buildings but those made of concrete or steel with masonry infill. These were of less concern from a non-structural basis since these building contained fewer people, less expensive equipment, and/or few hazardous materials.

Combining the RVS and the RVS-NS studies for the University, there are 22 buildings of concern. It was the recommendation of the study team that the University should examine these buildings more closely to determine which are truly of concern.

CONCLUSIONS

The Rapid Visual Screening for Non-Structural Elements seems to be potentially as powerful as a tool as the Rapid Visual Screen for Structural Elements has been for the last 20 years. The initial study indicates that even though the RVS-NS uses much of the same data as the RVS method, the analytic techniques provide additional information beyond the scope of the RVS method and therefore provide a broader picture of the true dangers due to an earthquake. The RVS-NS needs to be run on other building samples and by other researchers to test its potential.

I.3.2.1(b) Methodology for InCast Fields

The Inventory Collection Survey Tool (InCast) specified the data to be collection for each building. As not all of the fields corresponded well to the domain of higher education, a rationale and description for each input data in each non-structural field is provided below.

Methodology and Resources for field values non-structural assessment:

The following summary outlines the method for data input decisions for phase II of the DRU study for nonstructural assessment. In addition, the source for the information is included when remembered. Additional information can be found in the notes and files of Basecamp for the data and the source of the data.

InCast Field 16 Occupancy Class

Each calculation in the HMH, occupancy type and population is the base factor required for loss of life evaluation. HMH however allows for only one occupancy type allocation per building. It was determined to take the most prevalent occupancy type (i.e. “Assembly” for a stadium). The determination of occupancy class is based on the highest percentage of a building’s occupancy type. (i.e.: if there are multiple occupancies in a building such as labs, offices, classrooms, auditoriums, maintenance, etc., the category that occupies the largest percentage is what the building has been classified as).

There was discussion of breaking these spaces out as separate entities, however, this leads to questions concerning the effect to the fragility curves and how HAZUS may “see” these spaces. (i.e.: as multiple tall, slender profiled buildings, instead of one building) Changing to multiple spaces creates the additional work of inputting additional profile names into HAZUS, individually; there is no bulk download when adding profile names.

The data for occupancy type was retrieved from a report from Regina in Space Planning on campus that identifies each space within a building and its function. This data is parsed by percentage and actual square footages. This data was then queried to discover the dominant occupancy class for a given building.

29 Daytime Occupants
30 Nighttime Occupants

The HMH requires peak occupancy populations and non-peak populations. These have been identified at daytime and nighttime. The HMH was constructed for business assessment and not for a university context. Therefore, day and nighttime populations need to account for the worst-case scenario (meaning the most people) and therefore a time capture of populations was determined for 11:00 AM and 8:00 PM.

Averages could have been queried, however the model would not account for worst-case scenario. In addition, the difficulty with this method is that the report did not show the maximum populations for large lecture classrooms and event spaces such as the performing arts center and the stadiums as they are not scheduled as regular teaching spaces. These numbers had to be obtained separately by calling departments individually. It should also be noted that the departments assign many spaces within campus buildings. This data could not be captured as well due to time constraints.

A major drawback to the utilization of HMH for nonstructural risk assessment is that the loss of life is considered only for structural damage. Although death is very low as a result of nonstructural in precedent hazard events around the world, content and components accounts for over half of reported injuries.

GIS query by Adam Sobek for registered course number during 11:00 AM and 8:00 PM. Initially the 8:00 PM were showing unusually high numbers due to online courses. Online courses were taken out of both the 11:00 AM and 8:00 PM data to reflect actual bodies on campus during a scenario.

21 Building Replacement Value
22 Building Valuation Type
23 Valuation Year
24 Contents Replacement Value

Building replacement value, valuation year, and content replacement value were all determined as hard numbers. Valuation type is a text entry. The dollar amounts were entered in 3 digits.

The Utah State Division of Risk Management Property Values and Premiums for Fiscal year 2007 was used to determine the value of the buildings and the year of the valuation. The file “Inventory Assets” , was obtained by Mike Sauborin as the first data file in the inventory study. This is still posted on the Basecamp website. This data was used to determine the content value.

Often two values were listed and the meaning of which was unclear. We took the higher number in that event. Where a single building is divided into additional subordinate numbers, the total building and content dollar values were divided according to the square footage for all subordinates. Two pump houses listed a building value of less than $500, also not registering a value. 167 buildings did not list a content value on either report, or the value was less than $500, thereby not registering a value. Where buildings listed multiple content values and/or value listed as “inventory” or “other”, these values were combined to make a total content value.

25 Rental Income

Rental income is the dollar amount per month that is generated from renting facilities to another party. This data was taken from David Beckstrom’s fiscal financial report for the university in 2006. This file is not available, however portions are available upon request from the accounting office. Rents from student housing, and leased space to other institutions and organizations in addition to stadium rental, and rooms on campus are found in Category 4902 of the report. This information is given by department and was converted into a by building distribution.

26 Inventory Replacement Value

27 Business Income

Accounts Receivables portion of the fiscal financial 2006 report from David Beckstrom. The report was broken down per building from Auxiliary Enterprises Report and includes:

Bonded facilities (i.e.: Bookstore, dining services, vending services)

Non-bonded facilities (i.e.: Health services, athletics)

Service Units

Additional data available were rental costs assumed by the university for leasing space in Davis, Salt Lake and Utah Counties. Since no loss of property would be taken into consideration and a loss of function of these facilities is difficult to assign. Relocation costs were in the base AEBM fields, but not included in the InCast fields. Additionally, AEBM asks for Business Inventory, but InCast does not. I think this is a critical item that has been missed in the transition to the data capture tool of InCast. The report has this information available.

Loss of function costs are part of the algorithms in the AEBM, but are not called for in the InCast. I do not know how these are taken into consideration once we made the switch, but downtime and loss of function seems to be an important element to the study. A list of additional items AEBM asks for but are not captured in InCast are included in a file uploaded to Basecamp by Cynthia Argyle.

31 Kitchen Facilities
33 Dining Facilities

Kitchen facilities and dining facilities are inputted as a yes/no/unknown entry. Not all buildings with kitchen were designated ‘yes’. Instead, only full-service kitchens were included. Prep kitchens were omitted. Full-service kitchens were identified as kitchens with cooking facilities including a stove and oven. Buildings with dining facilities only included large capacity dining facilities were identified. Large capacity was identified in connection with the selected high capacity kitchens defined in the next section.

Peter van der Have was consulted on which facilities had kitchens and a few calls were made to identify buildings that he had question as to whether or not the kitchens were full-service kitchens.

32 Kitchen Capacity

34 Dining Capacity

The number of meals per day determines capacity of kitchens. Dining capacity was determined by number of seats. The kitchens identified in field 31 research as high capacity kitchens were queried only. High capacity kitchens were identified as cafeteria, or restaurant commercial kitchens excluding residential and warming kitchen facilities. These kitchens' production in meals per day and the number of corresponding seats in the dining area was determined by individual calls to the respective facility managers. The primary contact on record for the majority of the facility kitchen and dining capacity numbers for lower campus and heritage commons is Jerry Basford, VP for student affairs. The numbers for the kitchen and dining capacity for the hospital was obtained from hospital cafeteria staff.

The number of meals was estimated for lower campus and heritage based on estimated sales. For the hospital, on a full day of preparation for hospital in-patients and patrons of the cafeteria services were determined. The in-patients is tracks scrupulously and is accurate, the number of cafeteria meals prepared was an estimated number. Dining was determined by the maximum number of seats in the dining halls.

35 Sleeping Facilities
36 Sleeping Capacity

Sleeping facilities is a yes/no/unknown input. The only permanent sleeping facilities on campus are associated with students and faculty housing. A hotel is also located on campus at the University Guest House. These numbers were obtained from two parts of campus: University Student Apartments including East and West Villages, Medical Plaza, and faculty housing units. These total 64 buildings. The other portion of housing is the Housing and Residential Education including Fort Douglas new housing, Officer's circle and the Guest House for a total of 29 buildings.

Part 1data was obtained from Norman Chambers, VP of Admin. Services. Data on Fort Douglas including the Guest House was obtained from Jerry Basford, VP of student affairs. The number of residents in student housing is a fluctuating number. Both administrators for statistical data produce reports. Norm Chamber's report was used to determine the number of units and averages of persons per unit based on statistical data from previous years. Jerry Basford's report however was not available at the time of data collection. In order to plan for the worst-case scenario, the number of beds in the buildings determined the number of residents as the data input for Fort Douglas. If a bed was a full and larger, 2 persons were counted for that bed. This does not take into consideration individuals living in the apartments that are not registered with the University or children that come to student couples after the initial lease is signed.

37 Number of Hospital Beds

The number of hospital beds was determined by the maximum number of occupancy allowed by fire code for incapacitated individuals. The number is maintained per space within each building by Dan Lundgren's office and was obtained from Colleen Conley of health sciences. The facilities not only include the main hospital, but also the Orthopedic center and the Huntsman Cancer Center. The percentage of capacity at any given time is kept to a minimum of 90% according to the sources. However, to plan for worst-case scenarios a maximum occupancy was obtained for the patient spaces that comprise the medical buildings.

38 Number of Vehicles

Parking facilities on campus can be categorized into two classes: surface parking and covered parking. Surface parking is black top asphalt parking adjacent to buildings and includes those that are covered with a light canopy as well. Covered parking includes underground, structure and roof top parking facilities. Because surface parking is not directly influenced by the building data, for the sake of the study, surface parking was omitted.

The data for covered parking facilities and their associated buildings was obtained from Norman Chambers. The maximum number of spaces if the facility were full was determined as the input for the model. In the case of the LDS parking garage, the number of spaces dedicated owned by the University was included and the LDS parking spaces were omitted.

39 Hazardous Materials

Hazmat is a yes/no/unknown input. Michael Halligan, campus Fire Marshall, produced a report that outlines each building on campus that has the chemical materials they house. The report was evaluated and those buildings that house hazardous type materials were identified as 'yes' having hazmat. All others were determined to be a 'no' input.

55 Percentage of Contents of 1st Floor

The percentage of contents on the first floor was difficult to determine without going building by building inspecting all the floors. Due to time and budget constraints, a simple calculation was determined by dividing the building by the number of floors and finding the percentage of one floor. This included the basement(s) levels. For example, a 3 story building with a basement would have a data input of 25%. The number of floors was determined by the structural team.

A future study should consider this more specifically in light of soft story conditions and mission critical facilities that may be stationed on the first floor of buildings.

63 Ornamentation

This field has 5 classes: unknown, extensive, average, minimal, and none. As part of the InCast data set, Jesse Malan had photographed each building that had data except nominal buildings, such as storage facilities. The photos allowed the nonstructural team to evaluate each building and classify the building according to the 5 classes. No specific system for determining the classifications was decided. This field was completed intuitively by an architecture students versed in historic and modern architecture types.

66 Plumbing Bracing
67 Mechanical Bracing
68 Electrical Bracing
69 Ceiling Bracing
70 Mechanical Bracing on Roof
71 Bracing on Roof Tanks

Initial studies to discover the year of seismic upgrades to existing facilities not built under a seismic code for both lower and upper campus yielded disconcerting findings. There is not clear system of record for what buildings and portions of buildings have been designed and built initially with seismic measures or have had retrofits that have been seismically upgraded. This is in paper records and in drawings in plan rooms, but not readily accessible. In the interest of time and budget, the determination of bracing for all the above conditions was determined by code benchmark year and then compared with data on the construction year of the building. Therefore, if there has been a retrofit, this data has been omitted. A later study should take this into consideration. Additionally, the construction year does not account for the design year, which is likely to be the code year in consideration. Therefore, if a project was constructed just after a code change year, the older code was referenced.

This data on code benchmarking was obtained in cooperation with Bryan Romney, Code Official for campus researching the seismic code for nonstructural components from the early 20th century on. Major code benchmark years are as follows:

1935	bracing roof tanks added to nonstructural code
1973	ceiling bracing added to nonstructural code
	plumbing added
	mechanical added
	electrical added
1991	mechanical on roof added to nonstructural code
	more stringent codes for ceiling, plumbing, mechanical and electrical outlined.

Often codes are not implemented until years after they have been published. For example, the IBC 2000 code emerged and was the ruling code until the 2003 update was issues. Individuals and municipalities were still guiding the building process under the 1997 UBC code. Interviews with architectural firms in the area that worked on university campus buildings during the seventies and beyond indicate that some measure was taken for seismic bracing, therefore we can only assume that the code was implemented and followed. The field for bracing asks for unknown/yes/no. An additional field of level of bracing would allow for the parity between the 1973 and the 1991 code to be captured. The data for this model on 1991 bracing was not evaluated.

89	Mechanical Equipment Relative to lowest floor
91	Percentage of Contents in Basement
92	Percentage of Finished Basement
95	Enclosure Type

Fields 89-95 are flood related. Therefore, the nonstructural team gathered data concerning the buildings that were threatened by the hazard of flood and omitted all other buildings. The buildings included: Building 575 HSEB and Building 851 Orthopedic Building, and the NW pipeline building.

The NW pipeline building is a single story with no basement; therefore the mechanical equipment was on the roof, a simple estimation for field 89. Because the NW pipeline building has no basement, 91, 92 are irrelevant. The other two buildings were evaluated by their drawings obtained from the records department in the office of campus design and construction to determine where the mechanical was located in the building, the percentage of contents in the building, and the percentage of finished basement. The distance of mechanical relative to the lowest floor was found thorough elevation lines on section drawings. The percentage of contents in the basement was estimated based on the number of floors and whether special equipment including mechanical was in the basement. The percentage of finished basement was determined from plan drawings that identify wall types and those that are finished versus those left unfinished.

The enclosure type was determined from photos of the buildings gathered by Jesse Malan. Although the different faces of a building change according to the elevation, the buildings were familiar enough and few enough to visit and verify the enclosure percentages of solid wall versus opening

I.4 Detailed Analysis of Hazard Profiles and Loss Estimation

This section is based on guidance from FEMA 386-3 "State and Local Mitigation Planning – How-To Guide – Developing the Mitigation Strategy", Section 1-2. Because of the nature of the problems statements in Section I.4.2, this whole section should be considered confidential.

I.4.1 Findings from risk assessment

I.4.1.1 Causal factors

I.4.1.1(a) Earthquake – geologic forces under the Wasatch Mountain Range

I.4.1.1(b) Pandemic flu – spreads through human contact. Our large campus, including on-campus residences, puts us at high risk should an outbreak occur. This is further exacerbated by the large number of daily commuters and visitors to the campus.

I.4.1.1(c) Landslide – slope failure caused primarily by gravity, but often triggered by heavy rain or seismic event.

I.4.1.1(d) Flood – water inundation with a variety of causes. With the campus topology, natural flooding is almost non-existent. There is a 100-year flood plain that we determined could fill Red Butte Creek, but little to no damage is expected to University buildings. However, a flood caused by a dam failure at Red Butte Reservoir could potentially inundate a number of student residences at University Student Apartments.

I.4.1.1(e) Severe Weather – severe heat, cold, or meteorological events such as winter snowstorms, spring rainstorms, lightning and high winds. Because of the orthographic barrier of the mountains, the campus is susceptible to more precipitation (rain and snow) than the middle of the valley. We also have a vulnerable population of tall trees, which have been adversely affected by high winds, but which have not contributed to any significant damage.

Related to severe weather is the potential for slip-and-fall events. The natural slope of the campus, and the freeze-thaw cycle of residual snow fall, combined with the many miles of "hardscape" and pedestrian walks provide an environment where such events can and do occur.

I.4.1.1(f) Wildfire – most often caused by lightning strikes in dry vegetation areas.

I.4.1.1(g) Terrorism – many possible causes, mostly political. A related category of terror – campus violence – is may be caused by students, staff and faculty without a social safety net to stabilize them under stress.

I.4.1.2 Hazard characteristics

I.4.1.2(a) Earthquake – low probability, high-damage hazard with no warning

I.4.1.2(b) Pandemic flu – low probability, high-impact hazard with potential significant warning lead-time.

I.4.1.2(c) Landslide – low probability for campus geographic extent. The human cause component of this hazard may cause concern for the population of the Health Sciences component of the University's campus.

I.4.1.2(d) Flood – water inundation with a variety of causes. With the campus topology, natural flooding is almost non-existent. There is a 100-year flood plain that we determined could fill Red Butte Creek, but little to no damage is expected to University buildings. There would be response-enabling warning lead-time associated with this type of event.

However, a flood resulting from a dam failure at Red Butte Reservoir could potentially impact a relatively small number of student residences at the housing complexes located along Red Butte Creek, as well as basement or at-grade levels of University facilities, such as Orthopedics Hospital, Williams Building, and others. Warning lead-time would be very short in this type of event.

I.4.1.2(e) Severe Weather – severe heat, cold, or meteorological events such as winter snowstorms, spring rainstorms, lightning and high winds. Because of the orthographic barrier of the mountains, the campus is susceptible to more precipitation (rain and snow) than the middle of the valley. We also have a vulnerable population of tall trees, which have been adversely affected by high winds, but which have not contributed to any significant damage. The campus population and snow removal crews have adequate time to react to snow events, enabling appropriate response to prevent injuries due to slip-and-falls.

I.4.1.2(f) Wildfire – most often caused by lightning strikes in dry vegetation areas.

I.4.1.2(g) Terrorism – many possible causes, mostly political. A related category of terror – campus violence – is often caused by students without a social safety net to stabilize them under stress.

I.4.1.3 Critical assets in hazard areas

In addition to the points below, please see the vulnerability maps in Section H. Hazard Maps

I.4.1.3(a) Earthquake – The entire campus is in the earthquake hazard area. This includes classrooms, staff offices, equipment storage, laboratories, hospitals, critical infrastructure, etc.

I.4.1.3(b) Pandemic flu – All campus assets are in the potential hazard area, but with a focus on high-use classroom buildings and libraries which may be transmittal areas. The University Hospital is also a center for potential spread as infected patients may be highly concentrated there. Certainly, student-housing complexes also constitute a potential hazard area.

I.4.1.3(c) Landslide – Campus assets along the eastern fringe, including the hospital complex, health sciences buildings, and campus residences in Heritage Commons at Fort Douglas. Also worthy of note is the recent construction activities in the Health Sciences area which has cut into the slope, exacerbating potential slope failure.

I.4.1.3(d) Flood – Almost no buildings at risk from natural flooding. The only building that comes close is Building 851, the Orthopedic Center on Wakara Way in Research Park. It has not been determined if the loading dock of this building is in the hazard area of the 100-year flood plain. However, a flood caused by a dam failure at Red Butte Reservoir could potentially impact a number of high-population, high-exposure structures. (See G.2.1.1 (e)).

I.4.1.3(e) Severe Weather – severe heat, cold, or meteorological events such as winter snowstorms, spring rainstorms, lightning and high winds. Because of the orthographic barrier of the mountains, the campus is susceptible to more precipitation (rain and snow) than the middle of the valley. We also have a vulnerable population of tall trees, which have been adversely affected by high winds, but which have not contributed to any significant damage.

I.4.1.3(f) Wildfire – most often caused by lightning strikes in dry vegetation areas. There are no critical assets in known wildfire areas. The hillsides to the east of campus have little vegetation and therefore little fuel.

I.4.1.3(g) Terrorism / Violence – many possible causes, mostly political. A related category of terror – campus violence – is often caused by students without a social safety net to stabilize them under stress. Critical assets most at risk for this hazard are all classroom buildings and campus residences, as this is where most campus violence (e.g. an active shooter) takes place.

I.4.1.4 Vulnerability characteristics of critical assets

The following ratings, provided by FEMA, are used to describe the vulnerability characteristic of the University's critical assets. Also refer to Table 2: Hazard Ranking, in the main body of the document.

Very High – One or more major weaknesses have been identified that make the University's assets extremely susceptible to a hazard.

High – One or more significant weaknesses have been identified that make the University's assets highly susceptible to a hazard.

Medium High – An important weakness has been identified that makes the University's assets very susceptible to a hazard.

Medium – A weakness has been identified that makes the University's assets fairly susceptible to a hazard.

Medium Low – A weakness has been identified that makes the University's assets somewhat susceptible to an aggressor or hazard.

Low – A minor weakness has been identified that slightly increases the susceptibility of the University's assets to an aggressor or hazard.

Very Low – No weaknesses exist.

I.4.1.4(a) Earthquake – Very high

I.4.1.4(b) Pandemic flu – High

I.4.1.4(c) Landslide – Low

I.4.1.4(d) Flood – Low

I.4.1.4(e) Severe Weather – Medium Low

I.4.1.4(f) Wildfire – Low

I.4.1.4(g) Terrorism / Workplace or campus violence – Low

I.4.2 Problem Statements

Developing a list of problem statements is the first step to identifying what specific mitigation actions should be developed to address our specific risks and vulnerabilities. By its nature, this problem statement list should be kept highly confidential. It is meant to be comprehensive and to generate groups of mitigation actions that will address the individual problems.

I.4.2.1 Specific Earthquake Hazard Problem Statements

I.4.2.1(a) Two high-risk buildings (which are also high population critical spaces) are classified as un-reinforced masonry buildings. Specifically, the Union building (053) and Orson Spencer Hall (056) are more than 50 years old and suffer from low seismic construction codes.

I.4.2.1(b) The University Hospital may be potentially severed from major ground transportation routes. The fault lines cross major north / south transportation corridors leading out of campus. There are no alternative routes except via helicopter.

I.4.2.1(c) Rice-Eccles Stadium scored poorly on non-structural assessments. The glass in the West tower is susceptible to breaking in a strong seismic event, potentially covering the stadium seating below it with a large quantity of broken glass. Though the probability of the stadium being filled to capacity during an earthquake is very low, there is a high life safety risk for the facility.

I.4.2.1(d) Administrative Computing Services is located in the basement between the Park Building and the Student Services building, both of which scored poorly on the AEBM HAZUS run. ACS operates the PeopleSoft suite of applications, including HR and Payroll. While a policy regarding offsite backup of data is in place, the University is currently pursuing peer “hotsite” agreements exist with other institutions.

I.4.2.1(e) The Hospital has a dependence on water to function. In the event of an earthquake completely cutting off water supply, the hospital has enough water to last one day. There are, however, two large underground water reservoirs on campus in the hospital area. While they are inspected from the inside regularly, there is no indication what the condition is of the outside concrete walls. It is unknown if planning efforts identify these reservoirs as available water sources for the hospital, or if a memorandum of understanding exists with the owners of the reservoirs.

I.4.2.1(f) Many buildings on campus are considered low or pre-seismic code.

I.4.2.1(g) Many buildings on campus do not have sufficient non-structural bracing, especially laboratories. Part of the problem here is that there are so many spaces on campus each would need to be assessed by the occupant department's own staff. Mandating a comprehensive bracing program, or even a detailed assessment to understand the extent of the problem, are politically sensitive issues.

I.4.2.1(h) Many buildings on campus were constructed in part with funds from private donors (e.g. Eccles, Dumke, etc). There are no agreements in place obliging the original donors to help replace or rebuild the building should it suffer severe damage from an earthquake, nor to help cover the cost of structural mitigation activities for those buildings. These buildings will thus have to compete with other buildings for state funding, or other sources.

I.4.2.1(i) Hazardous materials stored in laboratories on campus are susceptible to spilling during strong ground motion earthquakes. A current effort is underway to identify locations and quantify volumes of hazardous materials, but the policy concerning storage may be loosely enforced and the quality of the container bracing is unknown, but expected to be intermittent and inconsistent.

I.4.2.1(j) General business resumption plans for the University following a severe earthquake are undetermined at this time.

I.4.2.1(k) Classroom buildings damaged in a severe earthquake may be unsafe for teaching for a considerable duration after an event. No known arrangements currently exist to lease temporary mobile facilities for campus, rent locations off-campus, or convert appropriate classes to alternative learning channels (web-based, etc.).

I.4.2.2 Specific Pandemic Flu Hazard Problem Statements

I.4.2.2(a) Pandemic flu may quickly spread in a highly social environment like a university campus. Food service areas (accompanied by areas where students gather), campus computer labs, and recreation facilities (including pools, showers, exercise equipment) are high-potential environments where transmission may occur.

I.4.2.2(b) Approximately 2500 students and a number of their dependents live in campus residences and apartments. These facilities are grouped into three main locations: south, southeast, and east of the main campus.

Closure of student housing may severely impact the campus community, and the ability of the University to fulfill one of its primary missions.

I.4.2.2(c) While a continuity of operations plan for pandemic flu is under development, it is unknown if a continuity of instruction plan exists in the case of a University closure due to a pandemic flu outbreak. This may take the form of web-based distance learning, mailed lessons and assignments, or instruction via local radio and television.

I.4.2.3 <u>Specific Landslide Hazard Problem Statements</u>

I.4.2.3(a) While no historic landslides have occurred close enough to the eastern edge of campus to warrant a threat, recent and current hospital construction projects continue to cut into the slope of the hill. This potentially weakens the slope and may induce local landslides. Other than geotechnical investigations that occur as part of the normal design process for each individual building, no broader studies exist or currently authorized to investigate how construction may change the natural potential of landslides in the immediate vicinity.

I.4.2.4 <u>Specific Flood Hazard Problem Statements</u>

I.4.2.4(a) While it has been shown that University property and assets are not at risk from recurrent flooding, modeling of potential dam failure in the Red Butte Reservoir (most likely a low-probability earthquake-induced failure) does put several buildings at risk, even as the probability of such an event is consider to be low.

I.4.2.4(b) Attempts to retrieve information from the Central Utah Water Conservancy District regarding the Red Butte Dam were relatively unsuccessful. DRU staff made repeated attempts to request details concerning the Dam Rehabilitation project (financed by National Defense Authorization Act for Fiscal Year 2000, not to exceed $6 million) to bring the dam in line with laws under the State of Utah.

I.4.2.5 <u>Specific Severe Weather Hazard Problem Statements</u>

Severe weather conditions, such as snow, ice and wind, will continue to pose an occasional challenge to the University campus. Very little damage has been reported to the University's permanent assets (noted exception being the "Bubble") as a result of those types of events. Slip and fall events pose a recurring challenge to the institution, and it is therefore important that (a) maintenance and snow removal programs address those challenges, and (b) designs for pedestrian walks, open-air gathering spaces, and entry ways include features that mitigate those risks.

I.4.2.6 Specific Wildfire Hazard Problem Statements

Wildfires may occur in the foothills east of the campus. Building designs, trail maintenance, and usage of these undeveloped areas in close proximity to University assets are currently cognizant of that threat, however minimal, and must continue to do so.

I.4.2.7 Specific Terrorism Hazard Problem Statements

The University has not experienced any significant events in this category. However, it is recognized that there is always a possibility that this will change, and the University cannot afford to ignore that risk. The Security Task Force, established by the University in 2007, has the responsibility for identifying and managing the risks associated with terrorism and workplace/campus violence. That process must continue to function.

I.5 History of Structural Mitigation at the University of Utah

I.5.1 History of Demolished Buildings

The following email contains information regarding building demolitions indicating that a detailed and extensive structural mitigation program has been operational at the University for some time. The table that follows the email is a list of demolished buildings.

I.5.1.1 Email Request

```
From: Ray Wheeler
Sent: Thursday, May 22, 2008 4:44 PM
To: John McNary; Tom Christensen; Lenard Barney; Eric Browning
Cc: Marty Shaub; Bruce Gillars
Subject:

To:    John McNary, Lenard Barney, Tom Christensen, Eric Browning

From: Ray Wheeler

Cc:    Marty Shaub, Bruce Gillars

Date:  May 22, 2008

Re:    Campus buildings demolished since 1991
```

Marty Shaub has asked Lenard Barney for a list of buildings demolished since 1991 to be supplied to our Trustees as an attachment to the University's Predisaster Mitigation Document, itself being submitted as an attachment to the Campus Master plan, in June. (The best way to mitigate for, say, an earthquake disaster in a seismically inadequate building, is to have completely demolished and removed the building….)

I have queried our "Building Master" table to create the attached list of campus buildings which appear to have been demolished. We have a "demolition year" field in our database but unfortunately, for older buildings, we do not always have a year given in that field.

I would ask the three of you greybeards, plus the beardless younger one who knows the history of the Fort Douglas campus pretty well, to review the rows highlighted in yellow on the attached spreadsheet, and fill in the "Demolition Year" column. Most of these building demolitions would presumably have been individual demo projects administered by Campus Design and Construction, and therefore having a "Completion Date" in the CD&C project database, or project file.

Or else they would probably have been associated with new building construction projects and would have been removed in association with a particular new building construction project as the first phase of that project, in which case the "Construction Start" date would be more relevant.

Please send your input to Marty Shaub with a copy to me, so I can place that "demo year" data into Building Master on the small chance that before I can early-retire someone else thinks of asking a question like this.

Ray Wheeler
Associate Director
Space Planning and Management
University of Utah

25 S. Wolcott Avenue
Salt Lake City, UT 84102
phone 801-581-7249
fax   801-581-4009
email: ray.wheeler@space.utah.edu

I.5.1.2 Record of Demolished Buildings

Table 21: Record of demolished buildings

Number	Building Name	Demolition Year
15	Dance (Demolished)	1986
16	ADP Storage (demolished '96)	1996
20	Physics/Ceramics (demolished)	?
21	Applied Research	1995
22	Geoscience Services	?
34	Concession Stadium (demolished '99)	1999
42	Ore Dressing Lab	2007
102	Physical Therapy (Demolished 2001)	2001
113	Education Research Bldg (demolished in 1999)	1999
122	Math Office Bldg (demolished)	?

123	Building 123	?
129	Math Office/Physics (demolished)	?
134	KUED/Media (demolished?)	?
155	Ballif Hall (Demolished 2006)	2006
168	Van Cott Hall (Demolished 2006)	2006
181	Austin Hall (Demolished 2006)	2006
243	Football Storage	?
307	Fac Maint Storage Bldg (demo 5/02)	2002
316	Storage Building 316 (demo 5/02)	2002
318	Warehouse Building #318 (demo 5/02)	2002
321	Greenhouse Storage (demolished)	?
322	Greenhouse #3 (demolished)	?
330	Storage Building 330 (demo 5/02)	2002
333	Pumphouse #3 (new) Qwest?	?
420	Outdoor Recreation (demo 5/02)	2002
423	Storage Building 423 (demo 5/02)	2002
430	Storage Building 430 (demolished)	?
436	Parking Services (demolished)	?
437	S&R/U Surplus & Salvage (demo 5/02)	2002
491	Seismograph Stations	?
502	Radiological Health (demolished)	?
503	Gross Anatomy Lab (demolished)	?
504	School of Radiologic Tech (demo)	?
505	Building #505 (demolished)	?
507	SOM Research Bldg 507 (demolished)	?
508	Building #508 (demolished)	?
511	SOM Research Bldg 511 (demolished)	?
513	Storage Bldg 513 (demolished)	?
514	Pharmacy Research (demolished)	?
517	Hosp Eng Machine Shop (demolished)	?
519	CVMB Research (demolished)	?
528	SOM/Hosp Offices (demolished)	?
553	Radiopharm/Radiology (demolished)	?
595	Rodent Ecology Genetics & Immun (d)	?
637	Fort Douglas Storage	?
641	Fort Douglas Bunker	?
651	Ft Douglas Pump House (demolished)	?
654	Fort Douglas NCO Club	2001 ?

I.6 Public Outreach

I.6.1 Articles

Peter van der Have (DRU Project Manager) wrote a number of articles as part of a public outreach program intended to enlighten and inform the University's population about the DRU project. The following articles appear on the DRU section of the Environmental Health and Safety website at http://www.ehs.utah.edu/dru, and are available to the general public.

I.6.1.1 Article: We are not alone

Peter Drucker made a daring, but so far inaccurate, forecast pertaining to higher education in a *Forbes* article published in 1997. He predicted that, within thirty years, "big university campuses will be relics." There is certainly no evidence yet that this is going to happen. However, as we progress into the world of "disaster mitigation," we might argue that unless our campuses implement significant disaster mitigation and response plans, they may simply cease to exist for reasons other than those that Peter Drucker may have had in mind.

In 2005, the University of Utah received the largest single grant ever awarded by FEMA to an institution of higher learning. This is largely the result of planners at the University of Utah having submitted a grant request to FEMA, promising to perform mitigation planning activities that had never yet been attempted by a research campus such as ours. The inference of that promise is both exciting and potentially overwhelming, inundated with the fear being that we are going where no one had gone before us. Fortunately we can rest somewhat at ease knowing that we are not exclusive and we are not exploring unmapped territories.

Before involving us, FEMA had collaborated with a small number of other universities. Each of those institutions provided valuable information regarding the basics of developing a disaster resistant university. These institutions are:

- Tulane University
- University of Alaska, Fairbanks
- University of California, Berkeley
- University of Miami
- University of North Carolina at Wilmington
- University of Washington

As a result of these collaborations, FEMA developed a document titled "Building a Disaster-Resistant University," published in August 2003. As it's *Foreword* says,

> *"This document is both a how-to guide and a distillation of the experiences of six universities and colleges across the country…to become more disaster resistant."*

For us, any or all of these universities is a partner and a resource as we progressively learn more about the project to which we are committed. This is precisely the role to be played by the University of Utah after the acceptance of the project by FEMA, the State of Utah, and the University of Utah's leaders. The main and substantial difference between the activities completed by those institutions and those to be undertaken by the University of Utah is that we intend to do a complete inventory of people, assets and risks that populate this institution at the current time. As much as existing resources allow, the investigation and resulting conclusions will be based on real data instead of broad assumptions. Additionally, our deliverables will include software technology and a summary of process activities and findings that should help facilitate a similar journey for other institutions.

As we explore our options, we have identified two of the above institutions as representing campuses with which we would want to collaborate particularly closely. One was UC-Berkeley and other one was to be the University of North Carolina. As the results and word of experiences associated with Hurricane Katrina became more widely known, we substituted Tulane for North Carolina.

U.C.-Berkeley

The University of California, Berkeley is no stranger to disasters. In the last two decades, earthquakes, mudslides, heavy rains, and wildfires have accosted them. Even before FEMA enlisted their help, Berkeley officials had one of the better disaster/emergency preparedness planning processes developed prior to that time, in the higher education community.

U.C. Berkeley's level of emergency preparedness has evolved through the development of a series of documents and experiences from which others, including the University of Utah, can and should learn. Not only do they have impressive documents, plans and organizational structures dealing with mitigation, they also have significant experience in developing response and business recovery frameworks. It is for all of these reasons, and more, that representatives from the University of Utah intend to meet with their counterparts representing Berkeley. There is much knowledge there from which we stand to benefit.

Current plans have a small number of us meeting with knowledgeable representatives from Tulane University, an institution that participated in FEMA's earlier work on the subject, and certainly had a painful real-life experience with a disaster shortly afterward. It is well known that Katrina hit Tulane very hard, and is currently working its way back to full business resumption. The following is a direct extraction from Tulane's emergency information web site (http://emergency.tulane.edu/):

> On August 29, 2005, Tulane University experienced the worst natural disaster in the history of our nation. The emergency plan we had refined and practiced many times over was subjected to the ultimate test. The plan and those executing it performed spectacularly. Still, there are many lessons we learned from Hurricane Katrina.
>
> We have reviewed those lessons and made adjustments to our hurricane plan. These modifications will ensure that we are fully prepared should another emergency threaten us.
>
> Tulane University is currently operating under normal conditions.

Tulane had a plan, and it likely helped to prepare them. The questions to be explored with their representatives will include

- Did the plan actually achieve its goals, and
- What changes might need to be incorporated into the plan to make it more effective for the next time.

Certainly, their experiences shed a new light on some issues they had not previously considered. We hope to learn from those experiences. Naturally, we cannot limit ourselves to only those two institutions and related agencies. As we move along the time line, we will avail ourselves of experiences and wisdom that have evolved at some of the other institutions listed above, as well as institutions, agencies and researchers who are commencing a similar journey.

I.6.1.2 Article: The hazards that await us

FEMA identifies a substantial list of the types of disasters that could affect communities, business entities and individuals across the states and territories of the United States. They include, but are not limited to:

- Avalanche
- Coastal Erosion
- Coastal Storm
- Dam Failure
- Drought
- Earthquake
- Expansive Soils
- Extreme Heat
- Flood
- Hailstorm
- Land Subsidence
- Hurricane
- Landslide
- Severe winter storm
- Tornado
- Tsunami
- Volcano
- Wildfire
- Windstorm

Utahns will undoubtedly identify a number of potential events off this list as highly unlikely to occur in this geographical area. Most of us would pick coastal events, tsunamis, and hurricanes as being the most unlikely events for our area. Certainly, the topography and general climate of our region precludes many of these events from ever occurring in this area. Even if some of them do surprise us, history suggests that they would have little or no significant impact. Therefore, all but just a few of the types of events listed above quickly fall off the list as we examine the situation at the University.

Wildfires

A common perception is that wildfires represent a type of event that is not too likely to affect us directly, either in the Salt Lake Valley or specifically at the campus of the University of Utah. There is certainly no record of any University-affiliated individuals or assets having suffered pain or loss as a result of wildfires. Is this condition the result of (a) luck and/or (b) good planning, and (c) can we count on the University of Utah always remaining immune from damage by wildfires? The answers to those questions are: (a) yes, (b) partially, and (c) no.

We do not have to look far into our area's history to become aware that wildfires do happen quite frequently in Utah, averaging close to 2000 per year. Wildfires in Utah are caused with relatively equal frequency by either lightning or humans (according to data at http://www.utahfireinfo.gov/ytd+media+links/yeartodate.htm). Neither one of those causes are likely to be mitigated. Since early settlers introduced an aggressive weed called "cheatgrass" into Utah, wildfires appear to be on the increase in both frequency and severity.

Wildfires will continue to occur. During the last five decades, several wildland fires have come relatively close to the campus. There is no history of a wildfire having had any direct impact the campus of the University of Utah, its people, or its assets—beyond having to deal with associated smoke and drifting ash. The institution is thus able to pursue mitigation planning and implementation of appropriate strategies, enhancing its ability to deal with wildfires. Such planning can proceed with the realization that such efforts will be important yet will not represent the most critical use of institutional resources.

Tornadoes

A study of the history of natural disasters quickly reveals that tornadoes are more common in Utah than most people realize. The files of the National Weather Service provide an excellent quick-glance resource for this type of data. The truth is that between 1950 and 2005, 143 tornadoes or waterspouts have been reported in the state—an average of less than three per year. Most of these happen in the months of May, June, July and August, with nearly two-third of them happening in the afternoon. They typically are much smaller in diameter and shorter in life span than what we usually witness in the mid-western region of the continent. Over the last 50 years, a majority of the tornadoes reported in Salt Lake Valley occurred in the western or southern half of the valley. The more significant ones that happened in the northeast quadrant of this valley tended to start downtown, and head in a northeasterly direction. There is no record or recollection of a tornado ever having impacted the campus of the University of Utah. Mitigation planning for tornadoes is thus not an effective use of time and resources.

Flooding and Inundation

Flooding is a type of natural disaster that has occasionally impacted sections of Utah and the Salt Lake Valley. During the last fifty years, the University campus has experienced some damage on or around it caused by weather-induced flashfloods. The amount of impervious sites (roofs, parking lots and roads) resulting from rapid growth of the campus amplified the scale of those flashfloods. The University has learned from those lessons. Its planners have for decades designed surfaces and run-off patterns in such a way as to collect and control storm-induced water flows, detaining them in specifically constructed basins in strategic locations. Given the topography and the history of the campus, it is highly unlikely that the threat of this type of flooding will increase.

Many Utahns will remember the situation that developed in 1983 when unusually high amounts of snow combined with a wet spring resulted in an unusually high volume of spring run-off. Local systems were unable to convey those flows out of the downtown area. The resulting man-made river down the middle of State Street provided almost comical relief to the community. The University of Utah was not impacted by this event, other than in its influence on traffic flows to and from the campus.

As a secondary event, inundation can be of more significant impact to the campus community. Broken water mains (domestic and high temperature hot water) and ruptured or non-functional sewer lines have certainly caused damage to the University's assets. Planners need to continue to find and implement design and operational criteria that will mitigate the likelihood of the occurrence of such failures, and ultimately reduce their impact when they do occur.

The location, age, and structural characteristics of recently renovated Red Butte Dam (east of the campus) certainly should cause the University's planners to maintain constant vigilance and a close relationship to its operators. Studies show, however, that if a dam failure were to occur today, it is unlikely that the University's assets would be impacted beyond minimal water damage. The greater impact will strike residential neighborhoods west of Foothill Drive, possibly including some of the basements in the northern quadrant of University Student Apartments.

Weather-related Events

Severe weather conditions have had a historical impact on the University of Utah. High winds have toppled large trees, and destroyed an air structure (the "Bubble"). Heavy snows have created havoc to traffic conditions and parking lots, while testing and pushing roof designs and conditions on existing buildings. Lightning has done some minimal damage to campus assets. Other than the situation with the Bubble, Risk Management files do not indicate a significant risk or threat resulting from such weather conditions.

The notable exception is the risk of "slip-and-fall" events, occasionally resulting from the freeze-thaw cycles of snow and ice on and around the pedestrian walkways in combination with a few pedestrians making unwise choices in footwear and paths of travel. A well-designed and implemented snow removal program and constant education of the University's populations will continue to help mitigate these associated risks.

Earthquakes

> *About 700 earthquakes (including aftershocks) are located in the Utah region each year. Approximately 2% of the earthquakes are felt. An average of about 13 earthquakes of magnitude 3.0 or larger occur in the region every year. Earthquakes can occur anywhere in the state of Utah. About 500 earthquakes are located in the Wasatch Front region each year. About 60% of the earthquakes of magnitude 3.0 and larger in Utah occur in the Wasatch Front region. Magnitude 5.5 - 6.5 earthquakes occur somewhere in Utah on the average of once every 7 years. – University of Utah Seismograph Stations*

Earthquakes represent the single most likely type of event to strike our specific region. Even though significant seismic events are extremely rare, certainly much more so than tornadoes or flooding, their size and frequency of occurrence are much more predictable.

Scientists feel quite certain that this area of the country is overdue for a substantial event—one of a scale that has not been experienced for over a thousand years. Clearly, this is the single type of event that holds the potential of causing significant casualties and loss of assets at the University of Utah. The threat is real, and the associated risks are substantial.

Research and planning activities associated with the DRU project therefore places primary emphasis on the development of strategies associated with this type of natural disaster.

I.6.1.3 Article: Disaster management overview

Disaster management and planning, as far as the general public knows, is a relatively new concept. For some of us, it refers mainly to what others need to do in terms of response after a natural disaster has struck. That is certainly an important aspect, but not the only one. True disaster management is like a four-legged chair, with each of the four legs being essential and indispensable. Similarly, there are four aspects of planning activities associated with disaster management, each of which acts interdependently with the three others.

A simple analogy will illustrate the differences and the relationships among these four components. Most of us operate an automobile. We can generally understand how it functions and how we should operate it.

Our society accepts the grim reality that automobile accidents will happen. In anticipation of such events occurring on a recurring and unpredictable frequency, we provide ambulances, EMTs, emergency rooms at a local hospital, and automobile insurance. As expensive as these measures are, we continue to invest our hard-earned dollars in them, hoping not to need them, yet realizing that we likely will – eventually. We plan our actions in anticipation of the event's occurrence, at least in part to control the potential impact of the event compared with what could happen if we did not have these measures in place. In the world of disaster management, this aspect is called "**preparation**."

When that dreaded event occurs, we should then have systems in place that help us remain prepared to respond. We dispatch police, firefighters, EMTs, ambulances, tow trucks, traffic management equipment, and other specialized resources that will respond to and manage the situation. With proper **preparation** planning, this personnel and equipment will already have been staged in a reasonable convenient location.

An amazing amount of coordination and communication has to occur during this stage, the "**response**" phase. This is the stage with which the public is most familiar. Respondents attend to the victims of the accident, while managing and redirecting traffic, controlling lookers-on, and other activities peripheral to the actual event. Respondents secure the area, attempting to assure the safety of individuals in the immediate surroundings, as they work on minimizing secondary impacts. They have been well trained to manage the situation.

Next is the "**recovery**" phase. The injured are at the hospital, the damaged vehicle has been moved out of traffic, which is now flowing more or less normally. Obviously, the casualties have our primary attention. They have to receive appropriate attention. Soon, the damaged light pole has to be replaced; someone has to repair the damaged road surface; we probably have to repair (or replace) the damaged vehicle. Possibly, temporary rental of a replacement vehicle is required. Special accommodations may have to be made at the injured party's home. Someone has to take the responsibility to find pertinent documents, receipts, and then file the paperwork with the insurance companies and the local authorities. These activities, required in order to resume a normal life, do not just happen by themselves…someone has to "own" them.

It is only after the dust settles down when frustration level reaches its highest peak. Most of us do not plan our lives around dealing with these types of activities. This is the phase, whether in our personal lives or in our working environment, where we are constantly learning from others who have gone through similar experiences. The nature and complexity of the **recovery** phase are heavily dependent on the amount of planning and implementation that went into the **preparation** and **response** phases.

There is one component of disaster management that we have not yet examined. That is "**pre-disaster mitigation**" planning. We first try to identify potential hazards or catastrophic events that can affect us and the places where we "live." With those potential events in mind, we then want to design (or modify existing) systems that will react favorably to and survive an event. We "engineer" it to perform well. The intent of all engineering, some say, is to develop a design that avoids failure. Even the most effective engineering cannot control human nature and skills. They still play a critical and mostly independent role.

We hope and assume that the manufacturer of our car has done due diligence in designing the car and its components. We expect to be reasonably safe us from harm and pain, in most foreseeable conditions. Proper design and assembly of the automobile is a huge first step toward *mitigating* the risk or threat of a potential, disastrous situation. Its designers provide systems (headlights, bumpers, air bags and seatbelts, for instance) that help achieve this aspect of **pre-disaster mitigation.** Motorways are being designed and constructed in such a way as to help decrease the likelihood of casualties associated with or the severity of automobile accidents.

Today's individuals are better informed than any previous generation. Thus, no one continues to believe that all the best designed and implemented precautions will eliminate the threat associated with automobiles. A report prepared by the American Automobile Association (AAA) indicates that, related to car accidents, 12 million insurance claims were filed in 2003. Thus, considering that approximately one-third of our population is under the driving age, each of us has at least a 7 percent chance that we will hit or get hit in or by an automobile.

Most wise drivers look at the automobile as an accident waiting to happen. This is certainly one reason why we spend so much time and effort on

- implementing processes (drivers ed., for instance)
- developing policies (laws, family rules, etc.) and

- designing systems (stripes on the pavement, traffic lights, regulatory and advisory signage)

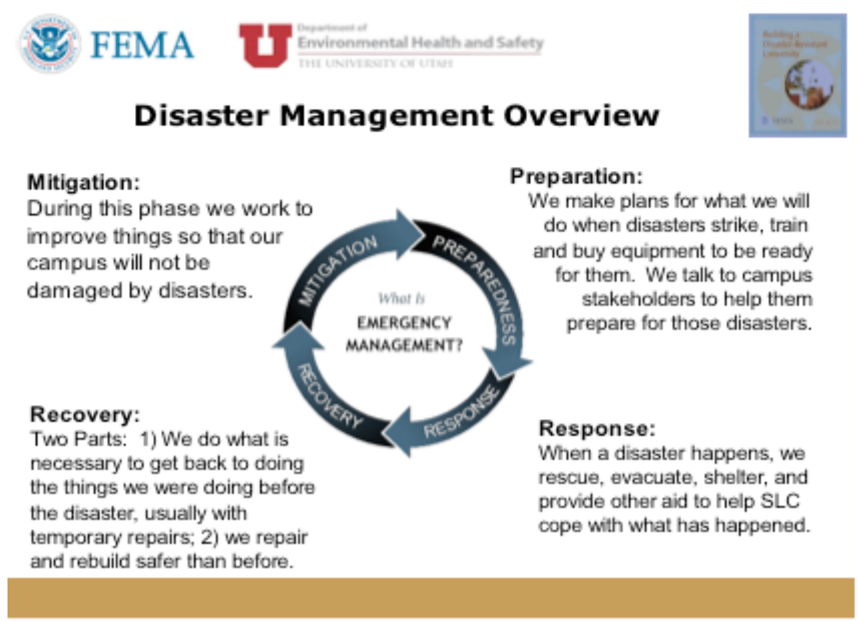
We do this in the hope that through proper implementation of these measures we can reduce the likelihood that drivers will get into a serious accident, hurting themselves or someone else. Most importantly, we hope to reduce the likelihood of an accident, and certainly the risk of injury or death. We are concerned, certainly, with protecting our investment in the car we drive. Most of us are even more dedicated to the notion of reducing the likelihood of death or injury to our family and associates. Identifying and implementing these processes, procedures, legal requirements, etc., is therefore also vital part of **pre-disaster mitigation planning**.

Extensive and collaborative **pre-disaster mitigation planning** can

- Limit or reduce the extent of the **preparation(s)** we need to have in place before the potential event occurs,
- Better define and limit the amount of **response** that has to occur during and immediately after an event,
- Positively affect the type and amount of **recovery** that has to occur after the initial impacts of the event have subsided.

In referring back to our analogy using the automobile, we still recognize that, after all of this planning, bad stuff can happen to us as we operate our vehicles. That is why most of us pay an average of almost $900 per year for an insurance policy that will help us **recover** after an event.

At the University of Utah, we interpret the relationship of the four components of disaster management as illustrated in the following graphic:



These four phases, or components, of disaster management are interdependent. We have to address them as unique aspects, but with an awareness of the objectives and the issues of the other phases. They have an unavoidable impact on each other. Thus, we do not have to invest in mitigation planning and implementation if we are not concerned about the cost in lives, or the amount of dollars and time associated with the recovery phase. We might be able to get away with not investing at all in mitigation planning and implementation, if we are willing to wager that we will never be the victim of the type of natural disaster(s) to which we might be exposed in our location. If it does happen, we must be prepared to pay a much higher toll in suffering and dollars, during the response and recovery phases.

Specialists in the field have studied the relationship between the cost of pre-disaster mitigation, and the cost of response and recovery associated with an actual event. The current consensus is that, in the case of the flooding that occurred in conjunction with Katrina, correctly building the systems that would have reduced the devastating effects of the flood would have cost approximately 1/4th as much as it will have cost to respond to and recover during and after the event. In a situation where the odds of a certain type of disaster occurring are predictably high, it is also a *smart* investment, with a very high rate of return.

In our setting at the University of Utah, with its large concentrations of patient care, research, and academic programs, informed decisions can also lead to smart investments that provide very favorable ROIs, not merely in terms of dollars, but even more so in terms of human pain and suffering, and on life in the larger community.

I.6.1.4 Article: Hazard Analysis at the University of Utah: Floods

> *Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. As much as 90 percent of the damage related to natural disasters (excluding droughts) is caused by floods and associated mud and debris flows. Over the last 10 years (1985-94), floods have cost the Nation, on average, $3.1 billion annually in damages. The long-term (1925-88) annual average of lives lost is 95, mostly as a result of flash floods. (USGS)*

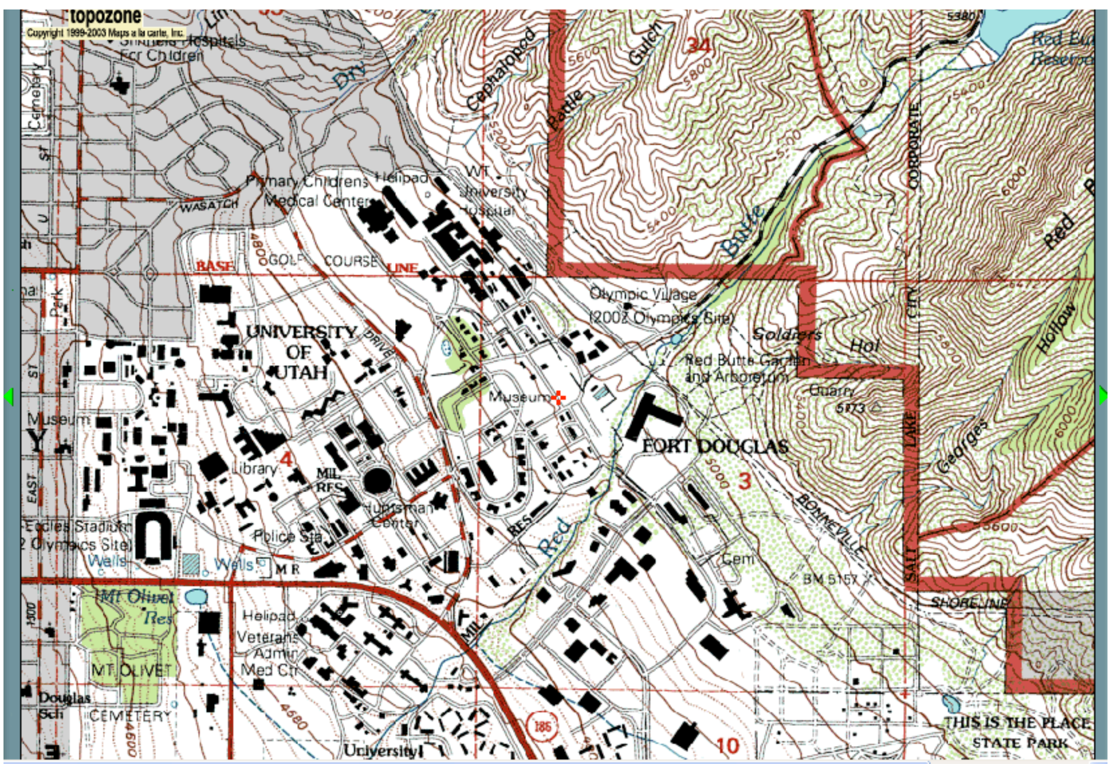
The preceding quote emphasizes the importance of planning for floods, as we look at mitigating the impact of disasters on a national basis. In Utah, we typically tend to think of potential disasters as being limited to seismic events. A few of us might remember to include tornadoes on a list of potential natural disasters and threats. Generally, the public at large pays very little attention to flooding in Utah as a serious threat, unless they have once been the victim of a flooding event.

In a recent 5-year period, the residents of the State of Utah have faced flooding events of a magnitude that few could have imagined. The Santa Clara and Virgin Rivers in south-western Utah have had a disastrous impact on surrounding communities. In the summer of 2008, communities such as Cedar City have had to suffer the consequences of flashfloods triggered by atypical, monsoon-like downpours not common to the area.

The Wasatch Front does, on occasion, also become the target for a series of heavy rainstorms, which in turn have led to fairly memorable flooding events. Fortunately, the campus of the University of Utah has been spared such an experience. Will this institution continue to be so lucky in the future?

Campus Profile

The foothills east of the campus constitute a significant watershed. In the event of a true 100-year storm, much of the precipitation that is collected in that watershed could potentially funnel itself toward the campus. Red Butte Canyon presents itself as the dominant likely source of a potential flood, particularly since it houses an earth-filled dam backing up a water reservoir. This storage historically supplied water to Fort Douglas and other federal properties in the immediate area. This dam and its associated causeway were recently reconstructed. Red Butte Creek, providing both the input and output associated with this reservoir, flows through the University's Red Butte Gardens from where it separates the University of Utah and the Stephen A. Douglas Center from the Research Park campus. Further to the west, the creek crosses through the VA's Medical Center campus, as it winds toward Sunnyside Avenue and Guardsman Way. Ultimately it meanders through residential neighborhoods west and south, and significantly downhill of the campus. Studies conducted in the 1980's suggested that, even in a rare actual 100-year storm event, the lower Gardens and certain Research Park buildings (including the Orthopedics Hospital) near the creek could suffer some property damage. There appears to be no reason to anticipate any loss of life as a result of such a flood event. The main campus will not be impacted by such an event.



Dry Creek Canyon is only slightly north of Red Butte Canyon, opening onto the valley to the north of University Hospital and the Huntsman Cancer buildings. It does not have a dam, except for a dirt-filled berm near the entrance to the canyon. Individuals who have been on campus for many years struggle to recall more than one or two occasions when a there was a detectable flow of water surface water in this normally dry bed during or after a significant storm event, or during a heavy spring thaw. Other drainages, such as Cephalopod more directly east of the Health Sciences campus, or Limekiln Gulch further to the north, similarly do not constitute a realistic flood threat to the University campus. (See map, below.)

Risk Analysis

The main campus is thus under no threat of flooding as the direct result of natural causes. However, the large, high-pressure water line that parallels eastern edge of the campus offer a secondary threat, as do the aging aqueducts that traverse the University through its very core. We must also remain aware of the underground oil lines that deliver millions of gallons of crude to the refineries north of Salt Lake City, as they run parallel to and uphill from the eastern edge of the campus.

Considering the volume of liquid that could be released during a system failure, experts consider it unlikely that any significant damage to the University's assets will occur as a result of associated inundation, even as a secondary event after an earthquake. The failure of any of these main arteries could, however, result in a significant impact on a number of critical campus functions and their collective ability to conduct business "as usual." In recognition of the potential risks associated with such an unlikely event, the University's public safety and environmental health personnel have established a direct link to the operators of those systems. Such a communication link will not prevent some damage of assets or interruptions of functions, but will most certainly provide an early warning system that will help prevent casualties. Flooding and inundation at the University of Utah, albeit of a unique type and scale, is a type of risk and threat that must continually be considered as the institution proceeds with Pre-Disaster Mitigation planning. In mitigation planning, the focus is as much on "possibility" as it is on "probability."

I.6.1.5 Article: Wildfires at the University of Utah: What are the odds?

[Article referencing Devinshire fire in 2006
http://findarticles.com/p/articles/mi_qn4188/is_20060824/ai_n16701352]

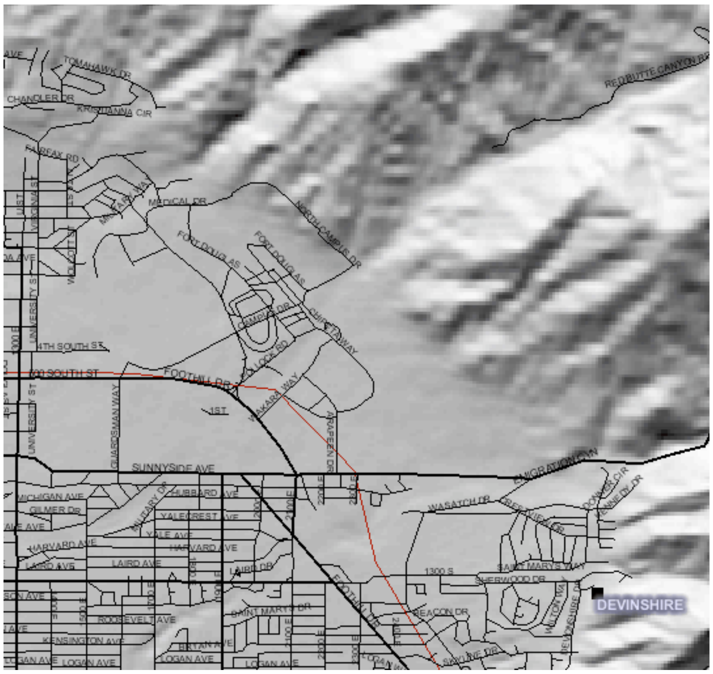


Image cropped from http://geomac.gov/viewer/viewer.htm on 20 August 2008

One of the potential disasters that FEMA has asked us to consider, as we scope the risk and threat of the various types of events that could impact our priorities in Predisaster Mitigation Planning, is wildfires.

We tend to believe that, in our immediate surroundings, we are highly susceptible to wildfires. It is a rare summer that we don't have to suffer at least several days, with smoke in the air so thick that we can barely see the sun, and as health warnings are issued to individuals who already have breathing challenges. There is no arguing with those perceptions, because they are true. However, there is more to the story.

The map shown above, as well as the two on the following pages, represents an assimilation of data provided by federal and state agencies that have data to offer, on this subject. **GEOMAC** is an acronym that stands for "Geospatial Multi-Agency Coordination." The maps themselves are prepared and made available by the US Department of the Interior.

However, the maps on these pages show quite clearly that the corner of the valley in which the University of Utah is located is almost unique in the State of Utah, and possibly much of the continental United States. For instance, Graphic A, focusing on the north-east corner of Salt Lake Valley (and therefore, the campus of the University of Utah), shows that there has been no wildfire activity reported since 2002.

If we zoom out to the next map, Graphic B, we can readily recognize that there has been a much more significant number of wildfires in the area roughly defined by Logan, Payson, Roosevelt, and East Wendover.

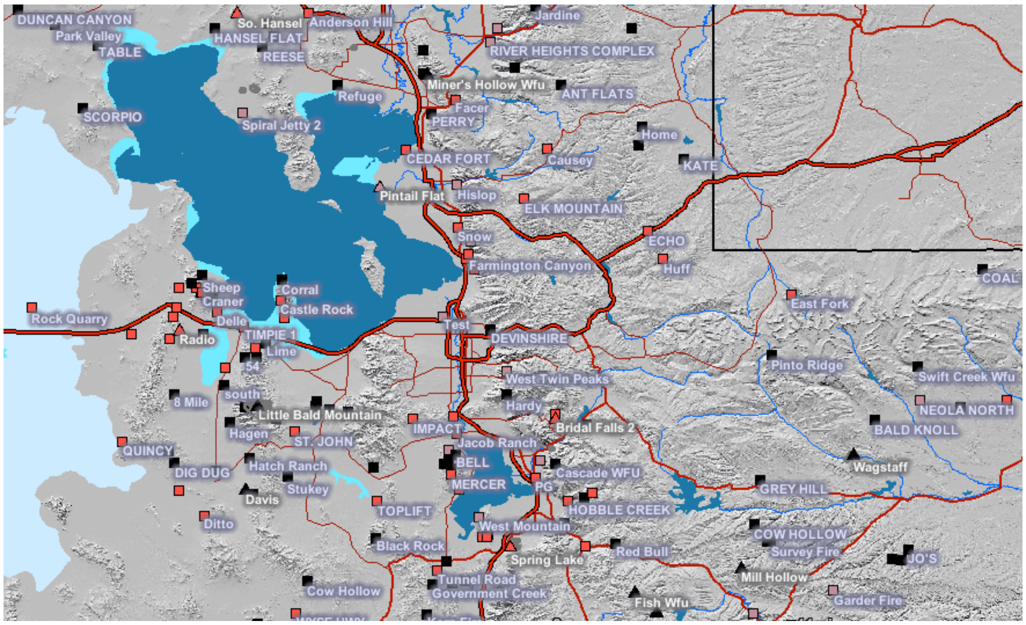
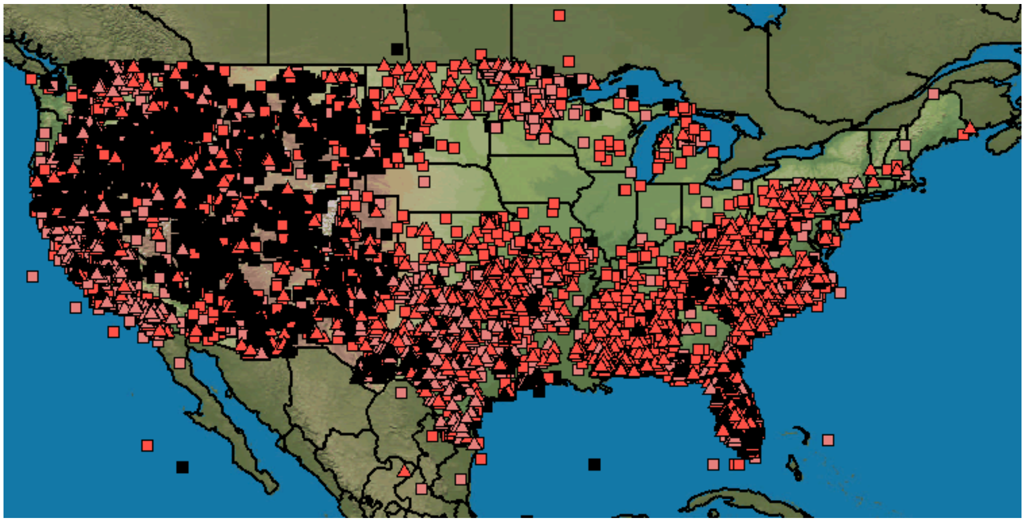


Image cropped from http://geomac.gov/viewer/viewer.htm on 20 August 2008

Several dozens of wildfires caused serious consternation in this slightly larger area of the State of Utah. There is little doubt that many of these events created the smoky days described above. Yet, they presented no other threat or danger to the campus of the University of Utah. Some of the remote properties owned or managed by agents of the University may have been impacted some, but without any serious threat.

Now examine Graphic C, below. As we zoom out even further, allowing us to look at the entire continent, we suddenly realize that wildfires are at least as serious an issue for the rest of the continental United States as they are for us, here in Northern Utah. In fact, there are geographical areas in the United States that are much more likely to be impacted by wildfires than we are.



Most of us are tuned in to the challenges facing Californians. As my wife and I recently took the 50-mile drive from Oakland to Napa Valley, we quickly realized that we are in a relatively good position, here in Salt Lake Valley. A drive from San Bernardino to San Diego will quickly lead to the same conclusion. Notice in the following graphic the number of events that occur in the mid-west and even in the southeastern areas of the country. (Note, by the way, how unscathed Michigan and Ohio remained during this period of time. Some of this may be the result of local agencies not sharing their data with "outsiders.")

All of this is not to say that the campus of the University of Utah can rest assured that it will never be under threat of a wildfire. Obviously, this would be a position that only a fool would maintain. Individuals who have been around the U for a long time will easily remember the fire on the hillside near the Block U, as well as the one that briefly appeared to threaten the eastern edge of Red Butte Gardens, only a few years ago. A couple of decades before that, the hillsides and ridges surrounding Emigration Canyon were up in flames, threatening homes and upscale "starter castles" in this and adjoining canyons. That time, the fire was contained before it became a viable threat to any part of the University of Utah.

There is always a risk that some foolish person will inadvertently (or, heaven forbid, intentionally) start a fire on Bonneville Trail above the U. Under the right conditions, such a fire could start to threaten the buildings, cars, and programs, on the very eastern edge of the campus. Yet, it is also true that geographical and human-built features of the area would also facilitate rapid containment of such a threat, rapidly reducing the likelihood of serious damage to the campus or any of its assets.

The buildings located along this eastern edge of the campus were designed and constructed with full respect being paid to the potential of wildfires. They were situation so that fire fighting equipment and personnel could have full access to all sides of the building, should this become necessary. Building materials and fire prevention systems were incorporated into each of these facilities designed to resist any wildfire, should such a threat become a reality.

It is important to reiterate that pre-disaster mitigation actions, whether implemented under the auspices of DRU planning or otherwise, have as a primary objective the protection of human life. Following those assurances, the protection of assets and economic health will receive appropriate attention, as determined by the mission criticality of each individual function, and as enabled by available opportunities and resources.

I.6.1.6 Article: Mitigation planning

Many of us who were in this area at the time remember the killer tornado of 2001, if only from the television shots showing how it cut like a hot knife through butter as it traversed downtown Salt Lake City. Some of us watched with awe as it sliced toward the campus early in its travels, eventually heading up to the Avenues.

Others remember the floods that besieged the Salt Lake Valley over the last half-century, along with some notable earthquakes. A few may also be able to drum up memories of several bomb threats that targeted areas either on or close to the campus, with at least one of them becoming actually being detonated.

All this goes to underscore that our community, as isolated as we sometimes like to pretend we are, is not insulated from disasters, human caused or otherwise.

On a national scale, we do not have to look back very far to observe, with the smug impartiality created by thousands of miles of distance, parts of the country being overwhelmed by heavy rains. We can recall the misery and devastation bestowed upon the Gulf Coast and New Orleans. We have seen or read reports in the media that showed entire communities being engulfed by the Mississippi River or the Red River, and others. College campuses were not exempt from these impacts.

Only several years ago, the normally very dry area of Utah's Dixie in Washington County experienced millions of dollars in damage because of a substantial flood. Before that, a dam failure northeast of St. George caused substantial damage to the area, including to assets belonging to Dixie College. Finally, serious concerns about pandemics further underscore the need for aggressive disaster planning.

These are only the "natural" disasters, without even considering the terrible events brought upon college campuses by shooters and eco-terrorists. Fortunately, colleges and universities in Utah have been largely immune from those types of violence—so far.

It is for such reasons that this University has and must sustain a deep interest in the planning process authorized by the Disaster Mitigation Act of 2000 (DMA 2000), signed into law by President Bill Clinton in October of that year. DMA 2000 looks toward local governmental entities to "develop and submit mitigation plans as a condition of receiving Predisaster Mitigation (PDM) and Hazard Mitigation Grant Program (HMGP) project grants."

Available to the University of Utah, and other institutions like it, are various disaster preparation and recovery assistance programs of which they may have to take advantage, some day. These require the existence of an approved mitigation strategy. These federal assistance programs relate to both natural as well as man-made disasters, and provide substantial funding support for projects designed to eliminate hazardous situations identified through the DRU planning process.

It is fortunate that the University of Utah already as a significant amount of data available that is required in order to develop this Strategy. Additionally, it is also fortuitous that the University has on faculty certain individuals who are experts in fields directly related to various components of the Strategy. Our initial challenge will be to identify all these critical resources, and while involving the right stakeholders, bring all potential players and all related data up-to-date. Where the data does not already exist, its absence must first be identified and then a protocol established where it can be assembled in a useful and timely manner.

The University of Utah made a giant stride forward by the achievement of this goal when it applied for and received a sizable FEMA grant. With a deadline of September 30, 2008, this Plan (or *Strategy*—a term preferred by the University of Utah) addresses the requirements imposed by DMA 2000. More importantly, it will provide a toolbox that will potentially provide guidance to other institutions as they begin the same process.

It is worthwhile to note that the process considers the physical infrastructure as an essential but non-exclusive component of the planning process. Careful attention will also be given to the human, societal/cultural, environmental, economic and other aspects of our campus community. Naturally, in terms of "functions" that occur on campus, the final Strategy must address the potential and the need for each of them to be able to recover after a catastrophic event, of the type considered in the scope of this project.

I.6.1.7 Article: Terrorism at the University of Utah

In the summer of 2006, Disaster Resistant University (DRU) planning team members kicked off discussions with individuals holding various leadership positions at the University of Utah. The primary topic for those meetings was the FEMA-sponsored Pre-Disaster Mitigation (PDM) project at the University of Utah. Almost immediately, they learned that this particular group of individuals tends to focus on two primary concerns regarding the University's perceived risk from two types of threat: (1) earthquakes, and (2) terrorism on campus.

It is, undoubtedly, no surprise to anyone on this campus that the risk and threat of earthquakes will dominate most of the activities associated with DRU. The deliverable or end-product resulting from this strategic planning process will be a document and a central repository of data that current and future administrators at the University of Utah can access to develop a solid understanding of the earthquake sensitive characteristics of our environment, and the risk and threat those characteristics pose to our every-day environment. Additionally, they will then have an opportunity to apply the DRU Strategy as they choose to mitigate those risks.

It is probably much less obvious to some campus constituents why we intend to dedicate less attention to a risk analysis of events potentially resulting from acts of terrorism. Consequently, the final product will not dwell heavily on a comprehensive pre-disaster mitigation strategy (PDM) designed to reduce the impact of such acts.

In late February 2007, the S. J. Quinney College of Law at the University of Utah hosted a forum on the subject of terrorism. Speakers of international renown shared and debated their professional opinions about the nature and characteristics of terrorism and terrorists. Fortuitously, the discussions helped drive home an appropriate assessment of the risk of terrorism at the University of Utah.

The public generally has an erroneous perception of terrorists. Contrary to the opinions held by many of us, terrorists do not fit into only a handful of several distinct groups. The public tends to think of terrorists as being religious extremists, political anarchists, or environmental radicals. This is an oversimplification. The truth is much more complicated than we might expect. Arguably, residents in ancient Persia and Palestine considered the Crusaders (who were mostly driven by their religious beliefs, disguised by economic fervor) as terrorists. It is true that terrorist groups are typically driven by one of those three “motivations” (religious, political, or environmental), dealing with or neutralizing the potential impact of each group requires understanding the cohesive forces that perpetuate the survival of each group. Adherents to Al-Qaida are not driven by a homogeneous fervor—they are may not even be of the same mind when it comes to the target for their hate.

Experts recognize that a single group of religious extremists may consist of disparate subgroups—each of which has its own targets and methods of attacking those targets—depending on the change(s) they want to trigger. Each of those subgroups can be as unique and different from each other as they are from the rest of us, and the subgroups to which we belong. Even where different groups have identical long-range objectives, their methodology for reaching those objectives can vary widely.

Another fallacy is the belief that today’s successful terrorist groups are effective because they are multi-national organizations held together by a single, powerful figure. Although some events (for instance, both WTC attacks and the attack on the USS Cole) are possibly the result of planning at a “headquarters,” it is likely more often than not the case that condoned or unofficial splinter groups plan the actions, and implement them. Simply “decapitating” any known multi-national group will not automatically eliminate or neutralize the cells or satellites nor of their activities. Ironically, both Osama Bin Laden and the U.S. have suggested that to “cut off the head of the snake” is the only way to get past the conflict, as they literally take aim at each other. The difference is that Bin Laden looks at the entire U.S. as a target, where U.S. strategists look at a single individual, Osama Bin Laden, as the primary bulls-eye.

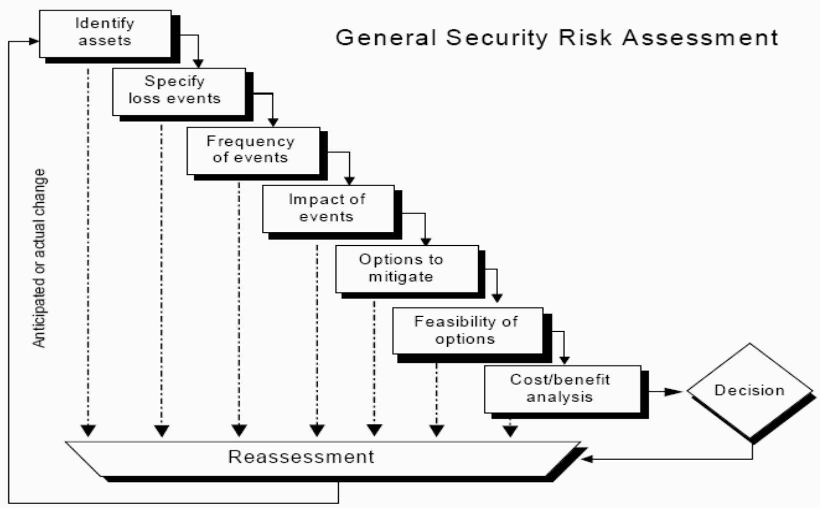
Similarly, experts on terrorism believe that just throwing more military personnel and weapons at countries that are suspected of hosting or breeding terrorists will not resolve the problem, and will probably provide more fodder to organizers of such groups. Some experts suggest that politicians would achieve better (long-term) results by investing in activities that lead to less misunderstanding and distrust, without compromising or threatening anyone’s belief system. The following assessment summarizes that perspective: values, not force, hold together society.

Groups we identify as terrorist are not necessarily seen by other societies in the same evil light. There are some groups, portrayed in the West as suicide bombers that develop substantial sympathies by performing constructive functions of social and cultural value in their own communities. A (not altogether unjustified) fear that the western way of live is going to destroy theirs continues to fuel their hostility, reinforcing their reliance on terrorism as a way to fight back. It also continues to bring in fresh recruits.

The recent event at a downtown Salt Lake City shopping mall created quite a stir among residents in SL Valley, and beyond. The shootings, perpetrated by a single individual, were quickly labeled by some as another attack by Muslim extremists. Reports were aired on the local television stations suggesting that people were fearful of going into shopping malls until they were sure that officials were taking precautions to assure public safety from such acts of "terrorism." As we now know, this terrible act was purely the act of a single individual who just happened to be Muslim. Regardless of the degree of violence, we cannot blame all such acts on known or unknown terrorist groups. More recent shooting events at universities and malls across the country, terrible though they are, had no relationship to terrorist groups.

The question now begs to be asked: Is this University perceived as a perpetrator of activities that threaten any group's value system or desired way of life? The goals of terrorist groups include wanting recognition on the world stage ("Publicity is the life blood of terrorism"—Margaret Thatcher), and/or causing a serious if not permanent interruption in the way of life of their target groups—enough so that those target groups (or others linked to them) become willing to implement the expected changes.

In 2001, the University of Utah was in the final stages of preparing to host the 2002 Olympic Winter Games. Security plans for the venues were in early stages of implementation when terrorists attacked the World Trade Center Buildings. Immediately thereafter, a contagious phobia spread across the campus causing people to demand, and expect, protection from similar catastrophic events targeting "their" buildings. Both in response to those demands as well as in preparation for the Games, venue planners as well as the University brought in teams of experts. They were tasked to examine activities that occur at the University, and to quantify the level of risk of terrorism that each of those activities might generate. The various participants in the process utilized an assessment tool much like this one:



Process Flow Chart. This flow chart graphically represents this process.

(Source: American Society for Industrial Security, General Security Risk Assessment Guideline, 2003)

The conclusion was clear and consistent with previous assessments: there were no targets present at this institution that appear on the radar of any of the known terrorist groups, in 2001. The only recognized targets on this campus, and only because of the presence of the Games, were the Athletes' Village and the Olympic (Rice-Eccles) Stadium. No other activities occurring on the campus of the University of Utah that we might consider "sensitive" or "at-risk" made the list!

There are centers of target-activities similar to some that occur at the University of Utah elsewhere on American soil. There are other research institutions that are more likely targets and will provide "better press" opportunities in support of terrorists' goals. Depending on one's point of view, it might be considered fortunate for us that an institution such as UC-Berkeley or M.I.T. is a more likely target than is the University of Utah.

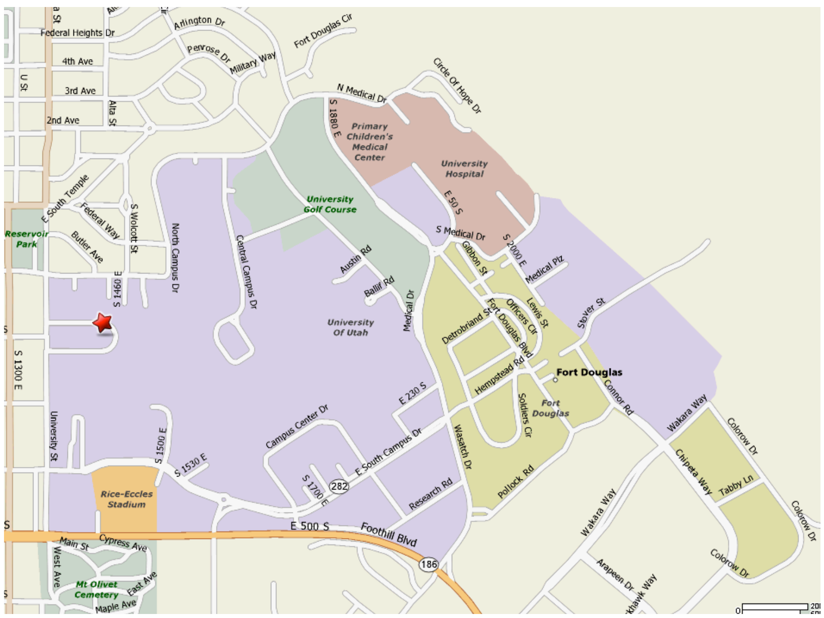
As we return to our discussions about planning for a disaster resistant university, we now recognize that making all facilities at an existing institution terrorist "proof" or "resistant" is not a reasonable objective. First, there is no reason to believe that this institution or any of its assets are a target for any organized terrorist groups, although local splinter groups or radicals who see themselves affiliated with larger causes (eco-terrorists, for instance) might not be predictable. Secondly, if there is a potential target, merely understanding the nature of the potential threat and then designing a fully prophylactic facility would be an exercise in futility, since both the target and the potential method of attack could change from one day to the next.

We anticipate that pre-mitigation planning activities addressing the risks of other types of disasters will inadvertently generate some policies and procedures that will address some risks conceivably associated with acts of terrorism. For instance, new buildings will be designed to high seismic standards. It would not be a huge leap or investment to design for earthquakes while simultaneously creating a more secure environment for potentially vulnerable programs.

Furthermore, we can and should develop protocols that will minimize the loss and accelerate the process of business recovery after either type of event.

Parallel to the DRU planning process, and as an after-effect of the shootings at Virginia Tech, the University of Utah created an independent Security task force with the assignment to study and make recommendations regarding issues associated with the types of "shooting" events we have seen recently, and the frequency of which appears to be increasing. Several members of the DRU Advisory Committee also find themselves on the Security Task Force, which has allowed the cross-pollination of ideas relevant to both camps.

I.6.1.8 Article: Neighborhood profiles (August 14, 2007)



Introduction

The campus of the University of Utah finds itself surrounded by every imaginable type of neighbor: city, state, residential, military, federal, corporate, wealthy, elderly, deceased, youthful, religious, and secular. It is thus that emergency planning has to be sensitive to the needs and priorities intrinsic to each of these demographic groups and political entities, to help assure a minimum of conflict and confusion prior to, during and after a hazardous or catastrophic event. For these reasons and more, the University is coordinating its emergency planning very closely with those of the surrounding entities, where they exist, and the State of Utah. The University of Utah recognizes that, although it has no rights of control (nor does it wish to have any) over its neighbors, its decisions will unavoidably impact the surrounding communities. It is with this reality in mind that this article attempts to identify the many, and diverse, neighbors of the University of Utah.

The main campus of the University of Utah is nestled in the midst of a community that is largely residential in nature. The surrounding residential neighborhoods are under the municipal jurisdiction of Salt Lake City. The University of Utah, as a state institution, is generally not subject to any of SLC's code and inspection requirements. Since the University of Utah relies on SLC's services for the support of such functions, notable exceptions include water and sewer regulations, as well as codes pertaining to fire prevention and suppression. Additionally, the codes enforced by the local health department, State Air and Environmental Control officers, and other such mandates are also applicable at the University and its programs. The University has its own fully trained and armed law enforcement officers (classified as Class A state officers).

The compass of the campus is somewhat offset from the norm. What is generally conceived of as "north" should in truth be called north-northwest. However, for clarity, this narrative will presume that the primary orientation is truly on a north-to-south axis.

East Neighborhood

Located on the fringe of the western foothills of the Wasatch Mountains, the uphill areas or what is generally perceived as the eastern edge of the campus is undeveloped. The University's intent is that this status will never be allowed to change. Past and current administrations of the University of Utah have committed to maintaining this status in perpetuity, as emphasized through the formation of the Heritage Preserve. The Preserve strives to assure that no additional development will be considered or implemented uphill from currently existing "improvements." Owners and managers (Forest Service, Central Utah Water Conservation District, Bureau of Land Management, and Salt Lake City) of adjoining properties were involved in the development of this document, as were entities that hold easements and right-of-way privileges through or above the Preserve (Chevron Oil, Questar, Rocky Mountain Power, Salt Lake City Public Utilities).

Several facilities that are owned by the State of Utah are located in the core of the Health Sciences portion of the campus. These facilities host activities that provide medical services to members of the statewide community beyond the University of Utah. Also located at this site are several state-owned laboratory facilities and the State Medical Examiner's offices. To the north of this site, Primary Children's Medical Center (PCMC) has established a sizable presence. Independently owned by the non-profit Intermountain Health Care network, this facility and all its associated functions are located on land leased long-term from the University of Utah. All of these health-care facilities and their associated programs are currently independent of any of the University's utility infrastructure.

A close operational link exists and is nurtured between PCMC and the University's patient care and research facilities. To support that activity, an enclosed pedestrian bridge connects the PCMC to the University Hospital and other Health Sciences campus facilities, located east (uphill) of PCMC. The bridge provides a critical link between the light-rail station (TRAX), located west of PCMC, and the numerous patient care facilities located uphill from the Medical Station.

North Neighborhood

North of the main campus is a very mature, upscale residential neighborhood, commonly known as “Federal Heights.” A high voltage Rocky Mountain Power substation, located on University property, is wedged into the foothills between Federal Heights and the Health Sciences area of the campus. This substation is the distribution point for one-third of the electricity delivered to the campus. It also provides service to the Primary Children’s Medical Center, and to some of the residential neighbors in this area.

Two privately owned facilities, the Children’s Center (essentially a day care facility), and the Jewish Community Center exist at the northeast corner of the campus. Both generate substantial traffic through the campus and the adjoining neighborhoods. Each one serves some of the needs for a small number of individuals affiliated with the University, but more so for the larger community. There is no organizational relationship between the administrators of these facilities and those of the University.

Although this residential area has a rather “colorful” history dating back to the second half of the 19th century, many of today’s residents in this area are representative of the upper crust of Salt Lake society. A number of University faculty and senior administrators reside here, including the president of the University of Utah as well as its senior vice president for Health Sciences. Both reside in University-owned mansions with their families, and use these facilities for numerous official functions. The University owns several houses just north of the main campus, used exclusively for administrative/office purposes.

Students reside in houses that were long ago converted for use by the “Greeks,” the fraternities and sororities associated with the University of Utah. This zone is situated between Federal Heights and the northern edge of campus. Some of these students’ alleged activities have led to friction between some of the neighbors, the Greeks, and administrators at the University. Most of these houses are located First South (100 South) Street, controlled and maintained by Salt Lake City’s Department of Public Works. These houses are private property and their occupants are not under the direct management or supervision of the University of Utah. Any influence that the University of Utah exerts on fraternities and sororities relies on more indirect channels, with frequent reliance on the national parent organizations for these “Greek” organizations, or on the Student Council. An even more consistent concern for many of the neighbors is the large number of commuters who choose to use First South and Federal Heights’ neighborhood streets to reach their destinations on the campus.

For many years, a nationally recognized 18-hole PGA golf course was located in this northern precinct. It was owned and operated by Fort Douglas—the military installation that once controlled much of the land on which the University of Utah sits today. Over the last 40 years, this golf course has dwindled to where it is barely a 9-hole course, albeit it remains popular with neighbors and students. Recently, the University announced its intent to allow construction of new buildings on the golf course. The 2008 season is scheduled to be the last year of use for the golf course. Construction of new facilities to be located on the course should commence before or by 2009.

West Neighborhood

Counterclockwise from “fraternity row” is the western boundary of the University’s campus, drawn as a hard line along University Street, another city-controlled street. On the east side of the street is what is generally considered the original and oldest portion of the campus of the University of Utah, with its historic buildings marking the perimeter of President’s Circle.

The neighbors to the west of University Street generally perceive the privately owned homes and the few businesses located along the west side of the street as “untouchable’ by the University of Utah. The few forays for expansion to the west, however briefly considered by the University of Utah, quickly met with fierce resistance by the neighbors and were soon abandoned.

The Newman Center, a religion sponsored facility for use by students of the University, is located on the west side of University Street, on the north side of 2nd South Street. It does not provide any space for official University programs.

The University leases a structure from the Church of Jesus Christ of Latter Day Saints, located on the northwest corner of 3rd South Street and University Street. The old label for this facility, “the West Institute,” is still recognized as its semi-official name. Previously used by the LDS Church as a chapel and meetinghouse supporting the LDS student population, the building is currently used as a classroom and lab facility under the auspices of the College of Fine Arts, mostly by the departments of Music and Theater, respectively. Several of the programs hosted in this building are designed specifically to for participation by K-12 children, drawn in from across the Salt Lake Valley. There is a constant din of activity in and around this building, especially during the summer months.

The Utah Museum of Natural History is located along this boundary, on the southeast corner of University Street and the south leg of Presidents Circle. The George Thomas Building, the host to the museum, was the original home for the University’s main library. Frequented by many pupils from the K-12 sector, as well as University students and the public, UMNH generates much traffic, vehicular and otherwise, through the adjoining community. This program will soon move to a new facility in the Research Park area. The University has not yet announced any plans regarding the future use of this facility.

South Neighborhood

A state-controlled highway, 500 South Street transitioning into Foothill Drive (US186), generally defines the southern edge of the campus. A cemetery that is operated by a private corporation on special use legislation but located on federal land, hugs approximately a quarter mile of the south curb along 500 South. A privately owned high-rise retirement facility is located on the southeast corner of 1300 East and 500 South. Further east on 500 South and east of Forest Hills Cemetery, the campus of the Veterans Administration Hospital defines the neighborhood along the south curb of the highway, as the primary direction of the highway bends slightly south, starting at approximately 1700 East. 500 South Street morphs into Foothill Drive at this point.

A pie-shaped piece of land is defined on it northern edge by another state-owned road (US282, known as South Campus Drive) as it reaches slightly to the northeast, and on its southern edge by 500 South/Foothill Drive. The University’s Rice-Eccles Stadium, with its inclusive Olympic Legacy Park (created as a public museum in commemoration of the 2002 Olympic

Winter Games) takes up most of the western portion of this land. Immediately west of the stadium's parking lot, a handful of privately owned residences continue to thrive. The University is currently exploring opportunities to partner with private developers to construct and operate a multi-use facility along the western edge of the Stadium Parking Lot, adjoining the existing Stadium Station for TRAX.

Further east, heading uphill, the University owns several heavily used parking lots, a fenced Salt Lake City-owned potable water reservoir, and a secured electrical substation, jointly owned by the University of Utah and Rocky Mountain Power. The University receives no water from the water reservoir, but receives more than a third of its total electrical power from the electrical substation.

Much of the daily traffic arrives at the campus through an artery located at approximately 1500 East (Campus Center Drive). The volume of vehicular traffic at this location is a perpetual point of contention between the University's residential neighbors (the Yalecrest Neighborhood Alliance) to the south and the University of Utah. Since the University is primarily a commuter campus, many single-occupant vehicles enter at this location, one of four primary entry points to the campus. TRAX, the light-rail system operated by the Utah Transit Authority, has greatly reduced the amount of vehicle traffic that the neighbors see on their residential streets, but has left them clamoring for more reductions. In addition to the daily commuter traffic to the campus, the unique traffic and noise generated by football games and other events hosted at the football stadium help perpetuate strained relationships with some of the neighbors, some of whom live several miles removed from the Rice-Eccles Stadium.

To the south of 500 South, as Campus Center Drive morphs into Guardsman Way (a SLC-owned street), the University of Utah operates several athletic support facilities, a competition baseball facility, and one of its parking lots. Salt Lake City operates a very popular recreational facility along this street, as well as a number of municipal ball fields and a park. Two privately owned and operated schools, including one for autistic children, recently opened their doors at the south end of Guardsman Way. To the south begins the Yalecrest neighborhood that is fully residential in nature.

Starting at 1725 East and directly south of South Campus Drive, the Church of Jesus Christ of Latter Day Saints (LDS Church) operates a number of facilities on sizable piece of land owned by the LDS Church. This piece of land is known to many as "The Church Triangle." The religious programs offered in the LDS Institute are completely independent of University curricula, but support the non-secular needs of the University's LDS students. A parking structure, also owned by the LDS Church, is situated east of the Institute Buildings. By agreement with the LDS Church, this structure helps serve the parking needs of the University's population, as well as patrons of the Institute, and park-and-ride TRAX passengers who work downtown. The University has a 20-year lease for most of the spaces in this parking structure. It is heavily used during basketball games and other special events at the Huntsman Center, located north across South Campus Drive.

Continuing further east on South Campus Drive, one crosses Wasatch Drive. This is another main commuter feeder artery to the general campus, as well as to the patient care facilities located on the eastern edge of the campus. East of Wasatch Drive, South Campus Drive becomes Hempstead Road as it heads toward the foothills. The relatively small piece of real estate east of Wasatch and south of Hempstead comprises a military installation, fully controlled and by the Department of Defense. There is no discernable interaction between this, the Stephen A. Douglas Military Reserve, the University of Utah, and the surrounding community. A recently installed and hard-to-miss fence around the Reserve emphasizes this relationship. It must be noted that most of the land on which the University of Utah is located was once part of Fort Douglas, with much of it having been transferred in the 1950s. Legislation is currently in place that, once the Pentagon decides to "surplus" the remaining military real estate, it will automatically transfer to the stewardship of the University of Utah. It was through this process that the historical Fort Douglas area, located to the north and east of the Reserve, came to the University.

Further to the south…

The Reserve finds itself sandwiched between the University-controlled historical Fort Douglas area, and the 700-acre University Research Park, further to the south and east of Foothill Drive. An independent corporation, managed by an executive of the University of Utah under the leadership of a governing board largely made up of senior level University officers, is responsible for the management of this enterprise. Private developers and/or corporations still own and control the majority of the buildings on land leased from the University Research Park Foundation. Most of the currently existing buildings will transfer to University ownership at some point during the next half century. Others already have. Based on visionary decision-making 50 years ago, the entire Research Park area does fall under the jurisdiction of Salt Lake City, with its building codes, planning and zoning restrictions, and law enforcement.

There are a couple of exceptions. The University Health Sciences controlled University Neurological Institute (UNI) and the Orthopedic Hospital are located in Research Park. Additionally, on the foothills at the eastern edge of Research Park, one finds University-owned Red Butte Gardens. This attraction brings in large numbers of individuals, both for daily tours of the wonderful gardens, as well as for special events such as weddings, outdoor concerts, and other special events. A large museum facility housing the Utah Museum of Natural History, currently located on the campus along University Street will open its doors to a new facility in or around 2010. This very popular museum will attract many visitors from across the state and the country, as it collaborates with Red Butte Gardens, as well as This is the Place State Park and Hogle Zoo, both of which are located south of the Museum site.

To the south of Research Park, and west of the "This is the Place" State Park, one finds University Student Apartments. Previously known as "Married Student Housing," this community of apartments owned by the University provides a home to approximately 1000 University students and members of their families. Approximately one third of these facilities date back to the 1950's, with the balance having been constructed during the 60's.

Completing the counterclockwise circle around the main campus, one comes upon the Red Butte Dam and Preserve, as well as the Regulated Waste Facility. The Red Butte Dam area is under the stewardship of the Central Utah Water Conservation District. The dam, built in the 1930's, was recently the subject of substantial restoration and reinforcements. The water behind the dam, originally used exclusively by the military installation to the west and other federal properties in the area, now serves as the protected environment for a number of threatened species of fish. The dam also serves as a detention device for flood protection against extreme spring snowmelt and heavy rainstorms.

The Regulated Waste Facility is tucked into the hillside east of the campus. It provides a short-term storage space for chemical and radioactive waste, until it is shipped to approved permanent storage or neutralization facilities. Only a few hundred yards to the west, across a very busy parking lot and road, we find the Heritage Commons at Fort Douglas, a University-owned student housing facility that provides a home to several thousand students and some families.

Conclusion

The University of Utah is dedicated to the development and sustenance of emergency plans that will serve the priorities of the University and its stakeholders, without compromising the safety and property of other individuals who happen to reside or work in locations that adjoin the campus. Key leaders at the University of Utah realize that the campus is not an island, and that decisions made on campus frequently impact the University's neighbors. For this reason, the University of Utah has long had the custom of holding public meetings, to which the public is invited, where ideas are shared and discussed.

Emergency planning and coordination is very much a part of those discussions. A conduit of open communication and technological linkages has been developed and will be maintained to assure congruity of pertinent emergency plans and priorities.

I.6.1.9 Article: Loss estimation characteristics and challenges

The road to arriving at an effective and meaningful pre-disaster mitigation strategy is built upon a substructure of data. The accuracy and completeness of that data will determine the strength of the ultimate mitigation strategies. To a substantial degree, the diverse sets of data accessed for this process provide the basis for loss estimation, which in turn help drive the decision-making process leading to the implementation of pre-disaster mitigation actions. The more complete and credible a set of data is, the more effectively it will help establish a ranked order of priority of those mitigation actions.

At the University of Utah, research teams have had to identify, locate and extract an amazing array of data that already exists at the institution, and upon which the Disaster Resistant University (DRU) planning process relies. The sources that had to be "mined" are dispersed and de-centralized, with access points and data stewards that are equally diverse.

The following discussion identifies the specific types of data that were tapped for the DRU assessments.

Inside buildings:

- Population characteristics: general classification (student, faculty, public, patient), daytime and night-time occupancies, relocation flexibilities of individuals (e.g. patient care).
- Programs: type, degree of mission-criticality, movability or flexibility
- Emergency or support functions: existing kitchens, sleeping facilities, dining facilities, relative capacities
- Economic characteristics: fiscal impact on the University, debt-service requirements, revenues, refunds, rental or other income, value of current research grants, wages paid to building occupants
- Inventory of non-building assets: types of equipment (capital and other), replacement value, potential impact on the environment, general vulnerability, locations, percent of content value on each level within the building where more accurate data was not available.

Characteristics of the facility and its location:

- Date of original construction or significant renewal, current replacement cost, structure type and characteristics, wall cladding and glazing types, pertinent building codes at the time of original construction and any subsequent upgrades, number of floors, seismic design level, locations of critical mechanical/electrical systems, bracing data, design wind speed, roof system characteristics, and other related data
- Soil type and characteristics, landslide and/or liquefaction susceptibility, ground water depth, grade variations, known or assumed fault lines, identified for the specific location of each structure

CHALLENGES AND OPPORTUNITIES

<u>People</u>

As can be deduced from the above lists, several of these data sets represent a huge potential loss portfolio to the University of Utah if they were to become a loss statistic resulting from a natural disaster. It is uncomfortably easy to become pre-occupied with economic and asset losses associated with the "tangibles", perhaps because those are easier to quantify. Perhaps for that very reason, the University's administration and the DRU Advisory Committee quickly pronounced that human life and well-being were to be the top priority in all-planning strategies.

One of the more difficult decisions DRU Planners at the University of Utah had to make was whether or not to place an actual value on human life, before even deciding on how much that value might be, or before struggling with whether one person's life could be worth more or less than another's (staff vs. student vs. faculty vs. patient, older vs. younger, etc.). There is a concern that placing any dollar value on any human life would place it in potential competition for priority placement with property, equipment, or other assets that might have higher assigned (or perceived) economic values.

> *There are credible estimates available from HAZUS…estimating the number of people that may be hurt or killed in various types of buildings under different hazard conditions. For the risk assessment it is important to note that the*

likelihood of people being injured or killed depends upon factors such as warning time and the characteristics of the hazard itself…[therefore] this guide does not place a dollar value on human lives FEMA 386-2: Understanding Your Risks

The DRU Advisory Committee elected to avoid such an untenable situation by stipulating that the primary objective of all DRU planning must be to eliminate risk of death or reduce the number of injuries resulting from a catastrophic event. The DRU Strategy will therefore focus on the potential actions that primarily save lives and reduce injuries as a result of a hazard event, and subsequently avoid or minimize negative economic impacts.

<u>Physical Assets</u>

Buildings

One method of identifying the value of a building and its infrastructure relies on the original construction costs. However, doing so creates a variety of estimated values that are unreliable. For instance, the use of such a methodology will ignore the cost of landscaping, sidewalks and surrounding pavement. Additionally, using original construction costs for buildings erected as little as ten years ago would grossly undervalue the building. It also would ignore, unless manually adjusted, improvements that were applied to the building since original construction. Another method would be to apply a current standard (i.e. RS Means) to the building's gross square footage. Although these types of figures are sensitive to local market conditions, they don't necessarily reflect the higher construction standards typical at a research university such as the University of Utah.

The DRU management team, along with the co-PIs, elected to use data already on file with the University's Office of Risk Management. This set of data is commonly used by institutions of higher learning for the purpose of estimating plant value. Consistent with traditional practice in the insurance industry, this information excludes construction costs associated with foundations, driveways, underground conduits, excavation costs, and other such miscellaneous "extraneous" costs. The typical margin for costs associated with these components is approximately 15% beyond the figures applied by Risk Management. "Soft costs," another component in the total project cost of building construction or major renovation, is also not included in these Risk Management tables. The margin for these costs is typically 30%. The total current replacement value for existing buildings, as recorded by DRU planners, is thus presented at Risk Management values plus 45%.

Demolition costs were not considered in the preparation of these values.

Utility Distribution Systems

Utility distribution systems, also thought of as "life lines," are a huge component of comprehensive pre-disaster mitigation planning. Included in this broad classification are distribution systems pertaining to water, sewer, storm sewer, natural gas, high temperature water, steam, chilled water, high voltage and medium voltage electrical, communication (fiber, copper, broadband, wireless, radio, satellite, etc.), and are external to buildings. At the University of Utah, an estimated 95% of systems are underground, with the main exception being the 132,000 volt systems that deliver power to the University's electrical substations, and the medium voltage aluminum overhead electrical lines that connect the Stadium Substation to University Student Apartments, located on Sunnyside Avenue.

The University has not yet had the opportunity to study this lifelines in terms of pre-disaster mitigation planning. A Utilities Master Plan (UMP), completed in 2004, accurately located these lines (using GPS) and inventoried characteristics of these systems. These data sets, now incorporated into a "spatial database" maintained by the University's Digit Lab (the same organization responsible for organizing all the other data associated with this project into a GIS format) are available as a layer of information to current administrators. They can also provide a foundation for research by future DRU planners. This is extremely important since the scope of this phase of the DRU planning project does not include careful evaluation of the utility systems in consideration of potential disasters, nor of the direct but secondary impact resulting failures may have on facilities and programs served by these systems. A rough estimate places the value of these systems, collectively, at over $400 million, without consideration of economic impacts resulting from their potential failure.

Capital Equipment

The University of Utah, like most institutions of higher learning maintains an inventory of capital equipment purchased through or by funds controlled by the University. The potential difference between this institution and others is the value at which equipment is capitalized. At the University of Utah, this is currently placed (by policy) at $5,000 or higher. All equipment of this value, when purchased, is added to the institution's capital inventory. When sold or discarded, it is (by policy) removed from the active inventory. Maintained by the Property Management Office in the Finance Division at the University, the goal and expectation are that this inventory is accurate and current, both in terms of value and in tracking assigned location of each asset. This information, therefore, was used to populate the appropriate data fields.

Insurable Equipment

At this institution, policy dictates that equipment with a unit value of greater than $1,000, but less than $5,000, is to be considered "insurable equipment." The University's Property Management Office tracks the inventory value of equipment falling into this category. However, this department is not directly responsible for *tracking* of the actual equipment. That responsibility is reassigned to the departments or units that "own" such items.

Presumably, all departments on campus maintain current inventory files tracking the status of all equipment in this category. Realistically, this does not happen with great consistency. Even those departments that enthusiastically accepted this responsibility and the work that goes with it, admit that providing any available data from such inventories to DRU Planners is not practicable. Since DRU planners were not able to locate an educated guess for calculating this value, these items remain excluded from these analyses. Recognizing that this is a significant gap in the prioritization process, one of the recommendations evolving from this process should be to re-examine the effectiveness and intent of the current policy.

Special Collections

The University is the custodian, either permanent or temporary, for invaluable items located in its museums, its libraries, and other dedicated locations. The true market value of these items cannot be reflected in these inventories; in fact, many of them may not have a representative market value that is acceptable to their custodians. One hurdle that has to be acknowledged is that custodians of special collections tend to over-estimate the true market value of their inventories.

Nevertheless, while this DRU analysis acknowledges the existence and the importance of those items, the value that is reflected within the DRU inventory is that which is recorded in the University's Risk Management archives. The expertise residing with the specialists in these organizations will no doubt come into play as mitigation actions are contemplated, in tandem with other University priorities, requiring case-by-case analysis by a variety of interested parties.

Economic Impacts

Wages

PeopleSoft has excellent data regarding payroll linked to specific individuals. The Finance Division was extremely helpful in providing this information to DRU researchers. Payroll/personnel files do not track the actual working locations for individuals on campus, and reported data only records the locations to which where Payroll forwards respective batches of pay notices. Thus, a flaw in the allocation process was uncovered when researchers attempted to link specific portions of a cost center's payroll to unique locations.

As an illustration, one might picture a multi-million dollar payroll for Custodial Services assigned to a relatively small building where the paychecks are received and ultimately re-distributed to a 200+ person staff who actually work in numerous buildings across campus. If a disaster were to happen during one of their shifts, information currently available through PeopleSoft would be unable to assign their respective costs to their exact working locations. Although rather unique in scale, this example equally pertains to some administrators, researchers, faculty, security personnel and police officers, etc.

Another un-scoped weakness in the collection of this data is the reality that certain individuals (i.e., researchers, medical staff, et. al.) may receive compensation from various alternate sources, some of which may not be tracked through the University's payroll system.

Income, Refunds, Revenue, etc.

PeopleSoft was able to share with the DRU researchers much data pertaining to this category. There is a reasonable degree of confidence in the accuracy of this information, since departments are required to deposit all such "cash-in" transactions into specific accounts and activities as defined in PeopleSoft. It is also reasonable to assume that such revenue or income is assignable to specific functions and locations—with the exception of housing functions. In this case, revenue is not necessarily tracked by specific building, and has been re-allocated based on certain assumptions.

Economic Impact of Loss on the University and the general community

In a meeting with Dean Jack Brittain (College of Business) and Dr. James Wood (Director, Economic and Business Research), the DRU team became aware that there was, in their opinion, no effective methodology for determining the amount of loss the community would suffer, over the long term, as the University progresses toward full business recovery after a significant disaster. In their opinion, the larger community (i.e. Salt Lake Valley and Utah) might actually benefit from an upturn in economic activity after such an event. They felt there is also no quick, effective method for quantifying the long-term impact on the University, shy of undertaking a difficult and time-consuming research project. For those reasons, DRU researchers have elected not to include any such considerations into this project, but will encourage the University of Utah to undertake or sponsor such an assessment in the future.

Research Grants

At “Research 1” institutions such as the University of Utah, the dollar value of grants awarded to researchers represents a major portion of the University’s total operating budget. Slightly over half of each grant is available to the PI (principal investigator) to support actual research activities. The University appropriates the balance to cover “overhead” costs associated with the cost of providing support functions and services (accounting, payroll, human resources, facilities, utilities and energy, etc.) that enable the research activity to occur. From one university to the next, there are numerous approaches and calculations that determine the amount and use of research overhead, which are generally determined by each institution’s administrators.

DRU research teams quickly learned that General Accounting and the Office of Sponsored Projects have an excellent handle on the value of research dollars that can be attributed to specific award recipients. The available information helps identify the “home departments” where those recipients are officially located or registered. This could be a college’s business manager’s office, or the dean’s, or other such central point.

As is the case with payroll information, a critical attribute that is not available through PeopleSoft is the identification of the location where the actual research activity occurs. Thus, research grants awarded to a large department with a full slate of varied research activities could very likely all be assigned to the building where the principal investigators for those grants are “officially” located—per their payroll information. While that level of accuracy certainly suffices for other purposes, it compromises the ability to identify locations where critical research activities occurred prior to a disaster, or the economic impact of each.

Another challenge resides in the identification of “project-to-date” value of research projects. For instance, there are numerous projects that have been evolving for a decade or more, having been enabled by financial support through various consecutive grants. In those cases, the DRU team was only able to identify the value of the grant currently in force. The impact of this data void is significant, in that it is currently not feasible for anyone to identify the total investment in current research projects. It is therefore not possible to identify the amount of re-investment that would be required (regardless of source) to bring a research project back to status quo. DRU team members failed in their attempts better understand the impact of this gap, including efforts to set up a pilot study.

As a result, the team recorded research dollars only in terms of current grants, pertaining to currently active projects, and referencing the locations where individuals responsible for related accounting functions, etc. are located. The effect, after a disaster, is that in situations where a disaster impacts a building where the research activity is happening, but not where the accountability for the supporting grant resides, the University may not be able to quantify or assign the actual economic losses associated with each of its research buildings. There is no doubt among the DRU project team members that this condition impacts the prioritization of pre-disaster mitigation actions, while optimistically hoping that such efforts will be tempered by an awareness of this condition.

Endowments

Endowments, unless they are program-specific, are typically not subject to the effects of catastrophic events, unless the linked program ceases to exist after the event. Since the DRU team does not believe that this type of situation is likely to develop to any significant degree, the team elected not to focus on this set of data, or to include it in the inventory process.

Risks and Threats

As the DRU team strives to identify potential losses under existing conditions, it has to evaluate and somehow quantify the likelihood of certain events happening, at certain locations. Known and yet-to-be verified fault lines, soil characteristics, flood zones, high wind velocity zones, wildfire proximity, potential terrorism targets, etc., are identified and superimposed over the inventories described above. In reference to earthquake related data, DRU researchers extracted relevant data from various existing sources already existing sources and files, mostly either at Campus Design & Construction, or at the researchers' own files. For other types of profiles or data, DRU researchers accessed information available at University Police, Environmental Health & Safety, Plant Operations, Risk Management, Dep't of Meteorology, US Forest Service, FBI, and other miscellaneous and credible sources.

PROGRAM CRITICALITY

The DRU Advisory Committee, on recommendations supported by Dr. David Pershing, Senior Vice President for Academic Affairs and others, agreed to adopt an assessment tool that helps categorize programs and activities on campus in terms of "mission criticality." This tool is based on a similar tool used by University planners in preparation for the 2002 Olympic Winter Games. It helped guide decision-making activities that could otherwise have been very subjective if not emotional.

As shown in Table I, the tool is a three-tiered structure that contains the following classifications: mission critical-uninterruptible, mission core – urgent restoration, and mission support – restoration as possible. Each one of these tiers specifies criteria and offers examples that helped DRU team members, with considerable input from members of the Advisory Committee as well as senior administrators, to categorize programs and official functions currently occurring on campus. The purpose of this tool is to enable the completion of this phase of the assessments with minimal bias or prejudice.

Category	**Criteria**	**Examples**
Mission Critical – Uninterruptible	Functions are critical to the mission of the University or the welfare of the state. Design should minimize risk and impact of interruption. In case of interruption, functions must be restored or relocated immediately.	Emergency Operations Team medical services & patient care public safety highly essential infrastructure hazardous material handling communications
Mission Core – Urgent Restoration	Functions are central to the mission of the University or impact community Design should minimize risk and impact of interruption In case of interruption, functions should be restored or relocated on urgent basis	student degree support (means must be found for students to complete on time) student housing Select research programs select service programs (counseling, community services) library services administrative data systems designated administrative and research support functions remaining infrastructure
Mission Support – Restoration as Possible	Functions are part of the mission of the University Functions are not targeted for application of prevention resources In case of interruption, functions will be restored or relocated as resources are available	academic areas – classrooms, offices, laboratories, study areas museums, theaters, sports facilities administrative offices not in Mission Core

TABLE I: MISSION CRITICALITY ASSESSMENT TOOL

CONCLUSION

For the University of Utah, the ultimate goal of this entire process is to eliminate the risk of injury or loss of life and to reduce the loss of property or other economic value as a result of unavoidable and unpredictable catastrophic events. By using the various tools already available to or being developed by the DRU team, the University will have available to it a central repository of the huge sets of data, as described above. Information has been assembled that projects, based on validated modeling tools, potential losses (including human casualties) as a result of the theoretical occurrence of certain types of events. The ultimate and final challenge facing the DRU team and the administration, as a key requirement of this project, is to prioritize its strategic options for the implementation of pre-disaster mitigation actions that evolve from the opportunities and needs developed through this DRU research.

I.6.1.10 Article: Goals and Objectives

Discussion: The vision courted by the University of Utah is to implement actions that will make the institution “fail-proof” in case of a disaster, with primary focus on an earthquake. “Fail-proof”, in this case, means no loss of life or significant injury, nor significant damage to or loss of property, and finally no interruption of mission critical or mission essential functions. This is to be achieved with the highest level of efficiency and effectiveness possible, even if not currently available. The success of the process will rely largely on the willingness of the campus population to support and nurture the Pre-Disaster Mitigation process promulgated under DRU.

Preface

The University of Utah is a very large and extremely diverse institution. For the last twenty-odd years, its management model has emphasized “decentralization,’ encouraging deans and vice presidents to be accountable and responsible for the successes of their own departments and colleges. This operating model anticipates that the central administration will develop timely, prescriptive guidelines and policies that will provide the guiding light to decision-making processes to be followed by the directors, deans and other administrators.

This operating model, as pertains to DRU/PDM mitigation planning, makes it both necessary and desirable for the project team to obtain from the University’s administration a relevant set of general directions and policies. In the lexicon of this project, those are the operating guidelines, the vision, mission, goals, objectives, and strategies upon which the road to project completion must be constructed.

The DRU Advisory Committee is comprised of senior level representatives representing the majority of constituent groups of the University of Utah. During it first fifteen months of existence, this group tackled numerous challenges, not the least of which was the requirement of defining the terms mentioned above. In all, they spent at least three full meetings before they were able to reach consensus on the descriptions associated with each of these terms. Those definitions, developed, endorsed, and approved by the DRU Advisory Board, are detailed below. These same definitions were subsequently reviewed and endorsed by the University’s senior administrators and ultimately the Board of Trustees.

Vision and Mission

VISION – The University of Utah will eliminate issues that it must otherwise address after a catastrophic disaster, primarily a significant seismic event.

MISSION – To identify, define, and implement those pre-disaster mitigation actions that provide “maximum bang for the buck” and will insure the greatest benefit to stakeholders of the University of Utah.

STRATEGY – Armed with an understanding of risks and degree of threat posed to the University by known hazards, we will engage our community in identifying and prioritizing specific mitigation actions, and in defining processes appropriate for the implementation of preferred actions.

Goals and Objectives

Goal 1: Preserve life safety

- Reduce the risk of catastrophic failure in occupied spaces
- Minimize secondary hazards present after an earthquake (falling objects, blocked exits)
- Protect critical response facilities

Goal 2 – Protect University assets and investments

- Reduce the risk of catastrophic failure in high value spaces.
- Minimize secondary hazards to high value assets (equipment, collections, records, samples)
- Protect the greater environment

Goal 3 – Ensure continuity of mission critical functions

- Reduce the risk of catastrophic failure to critical infrastructure.
- Minimize disruption to critical support functions
- Protect business resumption capabilities

Discussion: These statements and definitions make up the road maps and directional signs that the project should follow in order to arrive at a destination acceptable to the University of Utah's major stakeholders. This is not intended to presume that everyone on the University's campus will embrace the strategy and its many aspects. However, the discussions held at the Advisory Committee, and the resulting statements recited above, demonstrate clearly that the direction taken during the lengthy planning process was not simply the result of informal discussions held behind closed doors by a small number of potentially short-sighted and biased individuals

I.6.1.11 Article: Impact of PDM planning on post-event business continuity

The primary mission of the Disaster Resistant Planning project at the University of Utah is to eliminate the risk of injury and death, and to protect the economic health of this institution. Directly related to that mission is the unwavering realization that implementation of the "right" PDM actions will eliminate the need for knee-jerk reaction and haphazard planning for business resumption after an event.

One must analyze an institution's characteristics to assure an acceptable amount of business continuity or an appropriate rate of recovery in a post-disaster environment. It is thus essential that mitigation planners are constantly in tune with the aggregation of challenging dynamics that make a university a living organism.

Our “Business” Community

A large university is a complex organism comprised of a wide variety of business enterprises. The University of Utah, for example, lists a full range of activities or enterprises as core business activities, as exhibited in Table I, below.

TABLE I: Core Business Activities at the University of Utah

1. Teaching and learning; knowledge transfer
2. Research
3. Patient care
4. Internet and information technology provider for the state
5. Movie, television and radio program production and studios
6. Social (theatre, music, entertainment, etc.)
7. Child care
8. Retail
9. Food
10. Residential and housing
11. Competitive sports and athletics
12. Golf course
13. Industrial Health and Safety; Emergency Planning
14. Public Works
15. Law Enforcement
16. Parking and Transportation
17. Design, construction, operations maintenance: Capital Asset Management
18. Recreation
19. Archival Storage and Resource Libraries
20. Museums
21. Fleet management
22. Utility distribution systems operations
23. Power and boiler plant operators

24. Conference center operations
25. Financial Management and Accounting
26. Other

It is clear that this campus is not merely like a mid-sized city: It is a mid-sized city, and more, much more.

In a “typical” city, many of the aspects associated with the functions listed above are owned and controlled by private or pseudo-private sector organizations or individuals. The primary responsibility for the well-being of employees, customers, clients, and visitors resides with those individual businesses. The municipality provides tertiary or contributory support to those owners to provide an environment in which they can effectively conduct their business activities. Such services may include law enforcement, emergency services, fire prevention or protection services, enforcement of building codes, road infrastructure, public works, as well as certain utilities.

The Population

The unique difference between a typical city and a large university campus is that, generally often, the University centrally owns all assets required to perform this long list of functions. The central administration ultimately has primary responsibility for the well-being of all its “citizens,” visitors, and its many diverse assets. The complication resides in the reality that each dean, director, or chairperson has to behave as if his/her own program is the most important one on campus since he/she exercises day-to-day authority over that program and has full accountability for its successes or failures.

Another characteristic that makes a college campus unique is the daily migration of its population. The population count of a traditional city fluctuates moderately during the course of each working day, with the cycle depending on the demographics of the community. Being primarily a commuter campus, the University’s population may dwindle from a high of over 40,000 individuals on weekdays to only a few thousand at night and on the weekends, with only special events offering temporary spikes that last a few hours. That type and degree of fluctuation place a twist on both Pre-Disaster Mitigation (PDM) planning as well as business recovery planning, causing those two efforts to demonstrate unique requirements when contrasted against similar types of planning that occur at the typical municipal or state level.

Emergency planning at a research university with on-campus hospitals has to take into consideration a multifarious environment burdened with diverse intellects, egos and the resulting potentiality for highly biased perceptions of mission criticality. Planners must consider and find the tools to resolve differences of opinion, on almost any topic, that most certainly exist. Lacking that kind of resolution, an implementable pre-disaster mitigation strategy will remain an unachieved goal. Strong leadership and active involvement from the institution’s senior level administrators are thus essential. At the University of Utah, emergency planners have been fortunate to be able to work with that level of support.

The four components of emergency planning have to be consistent in recognizing the relative criticality of a function. This recognition provides a direction for planners and administrators as they determine the actions that the institution should implement in order to protect that function and to ensure its ability to survive or quickly recover after an untoward event. A PDM (pre-disaster mitigation) strategy successfully filters through any biases as its architects attempt to identify the measures that potentially provide the maximum "bang for the buck"—the most positive impact for the institution.

Planning for emergency preparation and response, the next two phases of emergency planning, has to be cognizant of such priorities as well, as procedures and tools are identified in anticipation of having to deal with a catastrophic situation. Finally, the business recovery phase has to have a road map identifying the functions, processes and systems that must be "resuscitated" first, as the University aims to regain a pre-determined level of functionality after a disaster.

PDM planners must constantly remain aware that there is a direct relationship between their successes in mitigation planning and implementation, and the ultimate success of the "preparers" and "responders" as they anticipate and prepare to deal with a disaster. Stated another way, if a proposed PDM action does not contribute in some way to more simplified preparation, effective response or timely business recovery, that action must be carefully re-evaluated before it is inadvertently implemented.

Identifying Priorities for Business Recovery

The preceding discussions highlight the complexities integral to a university environment. Clearly, it is not a simple, single-business operation. Planning for business recovery cannot be treated as a singular process. Planners and administrators should never underestimate the importance of recognizing potential options for business recovery as they relate to specific functions. Such recognition will help identify appropriate pre-disaster mitigation actions. Failure to do so may result in the implementation of PDMs that impede the business recovery process.

From a university-wide perspective, one of the primary considerations for business recovery, undoubtedly, is the need to bring back the students. Both Tulane University and Cal State Northridge learned that, even at a research institution, students are a primary driver sustaining the institution's very existence. Lose that source of income and other income streams will inevitably be negatively impacted. Officials at these institutions, and others, have discovered that designing appropriate redundancies of data files (transcripts, registration, financial aid, etc.), as well as security and signature files, plus providing the IT capability to provide access to them from anywhere, ranked at least as high as did the knowledge that their buildings would survive, or that replacement space could be located. Without ready access to those sets of data, administrators found themselves seriously constricted in "setting up shop" on a temporary basis. Student populations decreased as institutions were not able to respond, or were perceived as not responding, to student needs and expectations. Senior IT and student affair officers at the University of Utah have already designed and implemented a plan that will help address and mitigation this type of issue in case of a serious event.

Just as finding alternate locations for IT and data storage is critical, so it is for other primary functions of the University. For instance, experiences at other research universities, once having been impacted by disastrous, demonstrate that interrupted research can frequently be resumed at alternate locations. The key is that researchers and their support structures actively seek out such alternate sites, and work out "memos of understanding" prior to an event's potential occurrence.

Simultaneously, researchers must have access to and be willing to use a "knowledge" storage system that retains their critical notes and findings, while not relying exclusively on their own dedicated desktop computers and/or notebooks. It goes without saying, perhaps, that they need to be equally diligent with their research "products." The PDM project at the University of Utah, upon its completion, will identify the research facilities that may be the most vulnerable to significant failure after a disaster (such as an earthquake), hopefully providing motivation and opportunity for researchers housed in those facilities to make alternate arrangements.

Other mission critical functions and processes that occur at the University must pursue the same course of action. If it is determined that a certain function cannot survive an interruption of 30 days, 60 days, or longer (depending on the nature of the interruption), its leadership must take steps to identify alternate ways of providing business continuity as expeditiously as possible. Unit leaders must not assume that alternate sites will be readily available on the campus of the University of Utah, as identified by other individuals. Such sites will only be available if individuals have already taken the initiative to make succinct and specific arrangements, before the event. Otherwise, those potential sites may have to deal with their own challenges, or may have already been earmarked for other critical activities by other entities. Appropriate MOUs must be in place.

> *Ironically, managers of certain functions at a university don't necessarily think of themselves as being in charge of critical business units. It is important to the success of this level of planning that they receive the necessary motivation to help them change their perspectives*

Conclusion

Planning for business recovery in an environment such as exists at the University of Utah is not a process that can be achieved by a single individual. Each business unit must accept initial responsibility for such planning, taking into consideration impacts on or by its compatriots across the campus community. Its leaders must be painfully honest with themselves as they rank the functions over which they have responsibility in terms of "mission criticality," placing priorities in a realistic manner. The PDM Strategy identifies vulnerable areas; individual business units must be prepared to react to that information and apply it to the process of business resumption planning.

TABLE III: Emergency Planning Support Essentials at the University of Utah

1. Support from senior-level administrators
2. A standing Advisory Committee populated by individuals representing a majority of the business activities described above
3. One or more working committees that represent the best knowledge of the relevant sciences, related research, and the University environment

4. A prioritization process that "neutralizes" the effects of bias and prejudicial decision-making
5. A public education and forum process that invites constant and regular exchange of ideas and perspectives on recommended actions
6. A commitment to make this "DISASTER RESISTANT UNIVERSITY" planning process a permanent component of long-range strategic planning at the institution.

At an institution such as the University of Utah, this can only be accomplished by insuring continuous involvement on the parts of the leaders and other key players associated with all of the functions identified at the start of this document.

I.6.2 Board of Trustees Approval

The following excerpt is from the minutes from the Board of Trustees meeting wherein the substance of this mitigation strategy was approved. The minutes were obtained from http://www.admin.utah.edu/bot/minutes.html on August 19, 2008. It should be noted that the University of Utah Pre-disaster Mitigation Strategy is directly related to (but a separate component of) the Campus Master Plan. The Campus Master Plan, and thus the Pre-disaster Mitigation Strategy, was approved as Item 608 of the General Consent Calendar in the Minutes below.

I.6.2.1 Board of Trustees Minutes Meeting of June 9, 2008

THOSE PRESENT

H. Roger Boyer	Vice Chair
Randy L. Dryer	Chair
C. Hope Eccles	(on phone)
Clark D. Ivory	
J. Spencer Kennard	
Michele Mattsson	
Scott S. Parker	
Patrick Reimherr	
James M. Wall	

ABSENT

Timothy B. Anderson
Lorena Riffo-Jenson

UNIVERSITY REPRESENTATIVES PRESENT

Coralie Alder	Director, Marketing and Communications
Robert K. Avery	Professor of Communication and Chair, Student Broadcast Council
James R. Bardsley	Associate Vice President, Health Sciences - Finance and Planning
Keith Bartholomew	Assistant Professor, City and Metropolitan Planning
A. Lorris Betz	Senior Vice President, Health Sciences
Paul T. Brinkman	Associate Vice President, Budget and Planning
Jack Brittain	Vice President, Technology Venture Development
Norman Chambers	Assistant Vice President, Auxiliary Services
Ann L. Darling	Chair, Department of Communication
Jill C. Dawsey	Curator, Utah Museum of Fine Arts
David L. Dee	Director, Utah Museum of Fine Arts
Fred C. Esplin	Vice President, Advancement

Glen M. Feighery	Assistant Professor, Department of Communication and Vice Chair, Publications Council
Stephen H. Hess	Chief Information Officer
Chris Hill	Special Assistant to the President and Director of Athletics
Dan Lauritzen	Chair, Publications Council
Paul A. Mogren	President, Academic Senate
John K. Morris	Vice President and General Counsel
Thomas N. Parks	Interim Vice President, Research
Robert W. Payne	Associate General Counsel
Michael Perez	Associate Vice President, Administrative Services - Facilities
David W. Pershing	Senior Vice President, Academic Affairs
Rebecca M. Riley	Executive Assistant, Board of Trustees
Jonathan Shear	Associate Vice President, Investment Management
Laura Snow	Secretary to the University
Barbara H. Snyder	Vice President, Student Affairs
Jacob K. Sorensen	Business Manager, Publications Council
Jeffrey J. West	Associate Vice President, Financial & Business Services
Kim Wirthlin	Vice President, Government Relations
Michael K. Young	President

OTHERS

Steve Alder	Sunnyside East Neighborhood Association
Dustin S. Gardiner	Editor in Chief, Daily Utah Chronicle
Brian Maffly	Reporter, Salt Lake Tribune
Pete van der Have	Consultant, Disaster Resistant University

CALL TO ORDER

The meeting of the University of Utah Board of Trustees was held on Monday, June 9, 2008, at Kingsbury Hall. Chair Randy Dryer conducted the business of the meeting.

[…]

GENERAL CONSENT CALENDAR

[…]

Item 608 . . . Campus Master Plan

Vice President Perez thanked those involved on the Campus Master Planning Steering Committee for their work and insights. He explained that the intent of committee was to create a sustainable, pedestrian friendly, compact, and interdisciplinary promoting campus. Perez discussed the sustainability efforts for water collection. He noted that efforts are being made to transition away from culinary water use for watering the landscape and to reduce water usage by 50% . He explained that under the new master plan, most buildings would be within a ten minute walking distance; the Stadium Trax Station would be surrounded by a mixed use development; Health Sciences would grow to the west and south creating pedestrian corridors; and that an interdisciplinary quad would house the Utah Science Technology and Research (USTAR) buildings. Also included in the plan is the Student Life Center, new athletic playing fields, removal of the Annex buildings, addition of a Science Yard and Engineering Mall. Redevelopment of the East and West Student Housing Villages is also a possibility.

Consultant Pete van der Have discussed plans for a disaster resistant University. His group has been working closely with the master plan group to identify and manage potential risks. Their research has been funded by a pre-disaster mitigation planning grant from the Federal Emergency Management Agency (FEMA). Mr. van der Have stated that their goal is to control the consequences of the impact of an event and reduce downtime. Target activities include implementing a non-structural bracing program, defining vital document and record protection goals, supporting individual preparedness, and establishing an ongoing re-assessment of efforts.

Trustee Clark Ivory reiterated the need for traffic control and ample parking and urged management not to lose sight of these issues.

On motion duly made and seconded, it was UNANIMOUSLY voted to approve the Campus Master Plan as proposed.

[…]

Date approved: August 11, 2008

I.7 Field Trip Observations

Mitigation-related observations resulting from visits with representatives at UC-BERKELEY, LOUISIANA STATE UNIVERSITY and the UNIVERSITY OF NEW ORLEANS

(Intentionally not listed in order of priority or by institution)

- Individuals often have difficulty understanding the differences among the various phases of emergency planning, even at institutions that have recently been impacted by major events. Not too surprising, therefore, that some senior level administrators did not grasp the need or justification for **pre-disaster mitigation planning**.

- Both UNO and LSY had initiated some degree and type of emergency planning prior to Katrina, albeit with very moderate success. The momentum for such planning accelerated significantly after that event and the resulting floods.

- There are various ways of looking at PDM planning, or at least at the way proposed actions might be prioritized. The spectrum seems to run all the way from the purely “societal” or “sociological” to the more stoically based scientific and factual.

- The belief that data and technology rank very high in PDM planning, right after “people,” was substantiated during this trip, and pushed it even higher (student registration and financial aid, authentication, for instance).

- A rapidly increasing number of higher ed. institutions are entering the arena of emergency and mitigation planning.

- It appears to be easier to get funding for response and preparation than it is to get funding for implementation of PDM actions. This is important to remember that as we prioritize our actions.

- The success that UNO had with the completion of some of its PDM planning prior to Katrina enabled its administrators to more quickly develop a business recovery plan that aligns itself with the long-range objectives and strategies of the institution…and the surrounding community. It also enabled the accelerated implementation of previously identified mitigation actions, before the next event.

- Your most recent event will have an impact on current and future planning. The impact of an effective disaster mitigation plan can be emphasized by the last event, and can help define the next recovery plan.

- Neither LSU nor UNO had a policy emphasizing the need for planning, whereas Berkeley did (supported by the articulation of high expectations by the institution's chancellor). At LSU, once the chancellor's 100% support and funding came into the picture, planning activities received more attention by members of the campus community.

- The level of support that PDM planning receives from the campus community is directly related to the level of support openly provided by the highest levels of the institution's senior leadership. The level of VERY SENIOR level management involvement and influence was obvious. The Berkeley program was so successful because the Chancellor made it happen. The degree of success of any program (or failure) can be tied directly to that.

- PDM planning had not anticipated the amount of crime and violence that happened on the UNO campus (when school was closed) as a secondary event after Katrina. For instance, the absence of exterior lighting at night only served to increase the opportunity for illegal or destructive activities on the campus.

- At UNO, roof damage was severe. Gravel (a customary component of the built-up roofing system) caused an unanticipated amount of damage to buildings and windows when whipped off the roofs by strong winds. Resulting reports of lost or damaged documents were common. Design specifications have since been modified.

- UNO officials indicate that developing the ability to have critical buildings to stand on their own (with water/sewer, electricity, etc.) rather than being dependent on a campus-wide distribution system can diminish damage, down-time, and business recovery.

- At one of the institutions visited, the emphasis was significantly more on preparation and response than it was on PDM and business recovery. Another was more into PDM planning as well as preparation and response, and the third was quite heavy into all four arenas. Clearly, the level of planning was a direct result of emphasis and resources emanating from the institution's leadership, and was largely dependent on the professional orientation of the individual(s) leading the planning efforts (police, facilities, academia, etc.)

- UNO learned that it is difficult, if not impossible, to keep researchers and others out of their workspaces. A lesson learned for the Utah team is that future buildings could be designed in such a way as to facilitate maintaining this type of security, as well.

- Even during routine situations, occupants and departments tend to behave as if the spaces they use and occupy belong to them. This tendency becomes even more pronounced during emergency situations, as discovered by LSU and UNO. This can lead to life and asset threatening situations that an institution should want to avoid. Improved communications and strengthened protocols before the event can help mitigate such threats.

- The level of involvement at all levels (based on the rather limited number of units whose representatives we met at UC-Berkeley) communicated how institutionalized acceptance of the problem and the approach to creating solutions has become there. At Utah, we are still battling with some folks on the basic agreement that we live in a seismically active region.

- It is not so much that institutional policy makers don't want to get involved because of a lack of commitment. They just don't know what to do and what is expected of them. It is important to help them develop these skills. Emergency planning is overwhelming to people who are not in the business every day. Tendency can be to ignore this situation and hope it goes away.

- The existence of a PDM plan, or other emergency plan, does not guarantee that the leadership of an institution will fall in step with that plan when the chips are down.

- Don't deal with emergency management as an afterthought. Emergency management goes two ways: it offers support to as well as requiring support from everyone at the institution.

- Berkeley staff discovered that there are various ways of interpreting the same sets of data in (primarily non-architectural) certain arenas, such as personnel costs. Interpretations may intentionally or inadvertently be driven by whatever is already available at the institution.

- Building profiles, as recorded through InCast, can be assessed in various ways: one to one, one to many, several to one. This may be determined by the type of HAZUS output that is expected.

- Preparing a brochure highlighting successes in planning and implementing PDM actions can be a good move, especially if this brochure is widely distributed to campus constituents, visitors, and other stakeholders. Has to be done carefully and with unwavering administrative support. Berkeley made an intentional choice, resulting in a transparency of the program was outstanding – the walking guide told everyone exactly what they were doing. Does not leave much room for rumors and misinformation, yet did not result in an unwarranted amount of negativity about the program. Even the most intent naysayers realized the institution has a plan and was making progress in implementing it.

- One of Berkeley's more difficult challenges was determining how to quantify personnel costs.

- Berkeley faced a challenge in modeling the impact of disasters related to wildfires. They found that there was no model available, as there is with earthquakes. Berkeley did release a wildfire risk assessment tool around this time, but it is targeted exclusively to (communities of) homeowners. It does not help address challenges facing a university campus community. (http://firecenter.berkeley.edu/toolkit/)

- Berkeley performed their seismic loss estimations using three unique scenarios, which could be used as the basis for the U's estimations:
    - Level 1 Occasional, 50% probability of being exceeded during 50 years, estimated at a 72 year return period
    - Level 2 Rare, magnitude 7, 10% probability of being exceeded in 50 years, with a 475 year return period
    - Level 3 Very Rare, magnitude 7.25, 5% probability of being exceed in 50 years, with a 975 year return period.

- Continuity planning is pushed down to the department level and aided by technology in the form of the Continuity Planning Tool: http://bcptdemo.berkeley.edu

I.8 State and Local Plan Criteria – Crosswalk Reference Document

Table 22: Reviewer's Crosswalk reference

Plan Review Criteria Reference	Requirement	Section
Prerequisites		
Adoption by the Local Governing Body (3-2)	Requirement §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council)…	B.5
Planning Process		
Documentation of the Planning Process (3-6)	Requirement §201.6(b) and §201.6(c)(1): [The plan must document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.	A.3
Identifying Hazards (3-10)	Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type….of all natural hazards that can affect the jurisdiction…	D
Profiling Hazard Events (3-14)	Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard	D.3

	events.	
Assessing Vulnerability: Overview (Currently found under Identifying Assets section, p.3-18—to be corrected in next version of the Plan Criteria)	Requirement 201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.	D.3.1.1, D.3.2.1, D.3.3.1, D.3.4.1(a), D.3.4.2(a), D.3.5.1, D.3.6.1, D.3.7.1, D.3.8.1
Assessing Vulnerability: Identifying Assets (3-18)	Requirement 201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of: The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas…	D.3.1.1, D.3.2.1, D.3.3.1, D.3.4.1(a), D.3.4.2(a), D.3.5.1, D.3.6.1, D.3.7.1, D.3.8.1, and Section H. Hazard Maps
Assessing Vulnerability: Estimating Potential Losses (3-22)	Requirement 201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate…	D.3.1.1, D.3.2.1, D.3.3.1, D.3.4.1(a), D.3.4.2(a), D.3.5.1, D.3.6.1, D.3.7.1, D.3.8.1, and Section H. Hazard Maps
Assessing Vulnerability: Analyzing Development Trends (3-24)	Requirement 201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within	D.2

	the community so that mitigation options can be considered in future land use decisions.	
Mitigation Strategy		
Local Hazard Mitigation Goals (3-30)	Requirement §201.6(c)(3)(i): [The hazard mitigation plan shall include: a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.	A.8
Identification and Analysis of Mitigation Measures (3-34)	Requirement §201.6(c)(3)(ii): [The mitigation plan shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.	Section E. Recommended Hazard Mitigation Actions
Implementation of Mitigation Measures (3-36)	Requirement §201.6(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.	See all *Priority* and *Status* components of each recommended mitigation action in Section E.
Monitoring, Evaluating, and Updating the Plan	Requirement §201.6(c)(4)(i): [The plan maintenance	A.11

(3-44)	process shall include a section describing the] method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.	
Implementation Through Existing Programs (3-48)	Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate…	A.4.1, A.11.2, B.4.3.1
Continued Public Involvement (3-50)	Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.	A.11.2